TANGANYIKA

Annual Report

of the

Department of Agriculture

1956

PART II

1958
PRINTED BY THE GOVERNMENT PRINTER
DAR ES SALAAM
Price Shs. 10/50

~~N.S.P~~
R.A.M.
~~H.H.~~

COMMONWEALTH MYCOLOGICAL INSTITUTE
31 MAR

Annual Report

of the

Department of Agriculture
1956

PART II

Digitized by the Internet Archive
in 2025

https://archive.org/details/annual-report-of-the-ministry-of-agriculture-tanganyika_1956_part-2

CONTENTS

	Page
General Review	1
Western Province:	
Ukiriguru Research Station, General Report	4
Mwanhala Research Station	27
Maruku Coffee Station	30
General Experimental Work, Lake Province	33
General Experimental Work, Western Province	39
Central Region:	
Regional Research Centre, Ilonga, General Report	40
Regional Research Centre, Ilonga, Cotton Breeding	46
Regional Research Centre, Ilonga, Entomology	53
Coast Research Station, Bagamoyo	59
Coffee Research Station, Mbozi	62
General Experimental Work, Eastern Province	66
General Experimental Work, Southern Highlands Province	67
Southern Region:	
Regional Research Centre, Nachingwea, Plant Breeding	76
Regional Research Centre, Nachingwea, Entomology	80
Mahiwa Research Station	81
Northern Region:	
Coffee Research Station, Lyamungu, Summary Report	83
Plant Pathology, Lyamungu	89
Entomology, Lyamungu	92
General Experimental Work, Northern Province	94
General Experimental Work, Tanga Province...	96

TANGANYIKA

ANNUAL REPORT OF THE DEPARTMENT OF AGRICULTURE, 1956

Part II

GENERAL REVIEW

The re-organization of the research work of the Department on the basis of four Regional Research Centres supported by Research Stations and Sub-stations in differing agricultural zones is proceeding. Close liaison with research work in other East African Territories is being maintained through the Specialist Research Committees of the High Commission and conferences on special subjects organized by the East African Agricultural and Forestry Research Organization.

Central Research Region.

At the Regional Centre, a full experimental programme was carried out and it is clear that a wide range of crops can be grown but that work on maintenance of soil fertility would be fruitless in view of the high basic yields recorded and complete lack of response to fertilisers. On the agronomic side the future programme will be directed towards discovering the best ways of growing a wide variety of crops, the conservation of rainfall in the soil profile, the inter-relationship of plant populations and rainfall, the value of inter-cropping as compared with pure stands, methods of soil management and pasture management. The Entomologist (Empire Cotton Growing Corporation) is continuing his work on the insecticidal control of cotton pests particularly to see if it is possible to reduce the amount of insecticide below that at present recommended. The Plant-breeder (Empire Cotton Growing Corporation) is producing improved varieties for rain grown cotton areas and for irrigated areas with particular emphasis on a type of plant that will permit efficient use of insecticides for pest control. The Botanist will shortly begin a breeding programme on castor bean.

At the Coast Research Station the programme has been expanded to include general crops as well as beginning some work on the fertiliser requirements of mature coconut palms and a preliminary investigation on possibility of utilising the maji-moto ant (*Oecophylla longinodes*) for the control of the pest *Pseudotheraptus wayi*.

The programme at the Coffee Research Station, Mbozi, is also being expanded but coffee will still remain the chief crop for research work.

A sub-station is being built at Wami to serve the Wami-Magole area.

Western Research Region.

It is intended to expand the Ukiriguru Research Station into a Regional Centre but this must await a big improvement in the water and fuel supply.

The programme at the Maruku Coffee Station has been completely re-organized. The main portion of the programme is devoted to coffee research in areas where coffee, chiefly Robusta, grows well. A small amount of specialized work will be done on the station. Selection of suitable clones, manuring, shading, cultivation and pruning are the main features of the programme. A subsidiary programme has been begun to try to improve the productivity of the poor leached sandy soil on the station by means of deep-rooting grasses and legumes and fertilisers and manures. Some attention is being given to animal feeding and pasture work will start if some improvement of fertility can be effected.

Very useful work has been carried out at the Mwanhala Research Station in the past on the effects of fallows and shed-manure on yields of subsistence crops. The programme has been re-organized to place more emphasis on the production of cash crops and to test the value of fertilisers. Rainfall conservation will be a salient feature in the programme on account of the erratic distribution locally between and within seasons.

Southern Research Region.

In preparation for taking over the research work of the Tanganyika Agricultural Corporation at Nachingwea, where the Regional Centre will be sited, three officers have been seconded to the Experimental and Research Department of the Corporation. The research programme of this Department is directed by the Assistant Director of Agriculture (Research) and so the take-over will proceed smoothly without any major break in the work except for that on the experimental farm. A new experimental farm with a wide range of soil types will be established on a production farm that has been under cultivation for some five years. The Botanist is continuing the programme of the Tanganyika Agricultural Corporation plant-breeder. Emphasis is placed on soya beans with sunflower, sesame and sorghum taking second place. It is hoped to gather together a wide range of clonal material of cashew. The Entomologist has begun an ecological study of pests of cashew with special emphasis on *Helopeltis spp.* The Field Officer who will be in charge of the new experimental farm is assisting on the present experimental farm. A small sub-station has been established at the Prison Farm, Mtwara, for the coastal sands area.

Northern Research Region.

The building of new laboratories has begun at Tengeru which will be the Regional Centre.

General.

Small experimental stations have been established on five potential areas for irrigation. Three of these have been established by the Tanganyika Agricultural Corporation and two by the Department. The research programmes have been drawn up by the Assistant Director (Research). A wide range of crops will be grown during the rainy and dry seasons to

determine the best crops for each area and some work has been begun on the maintenance of soil productivity. This work will expand considerably later.

A Territorial Research Policy has been drawn up to give a sense of direction to the research staff. The aim is to build up a number of soundly based systems of agriculture centred on perennial crops, annual arable and food crops together with livestock products. Great importance is given in the programme to the production of a wide range of cash crops and to the improvement of soil productivity.

UKIRIGURU RESEARCH STATION

INTRODUCTION

By J. E. PEAT

RAINFALL

UKIRIGURU

January, 1956 to December, 1956

Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
4·38	4·85	4·93	5·80	4·52	—	—	1·17	0·64	1·10	3·32	4·32

= 35·03 inches.

LUBAGA

January, 1956 to December, 1956

Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
4·91	5·11	3·62	6·50	1·04	—	—	—	0·21	—	2·38	4·17

= 27·94 inches.

The season had a very good rainfall distribution, one of the best experienced at Ukiriguru. Rainfall was above average—34·88 inches from the 1st October until the end of June. In April there were falls totalling 5·8 inches and in the first week in May, 4·5 inches. The December rains were also on the heavy side.

At Lubaga rainfall during the same period was 28·94 inches, with a very reasonable distribution.

Introduction.

Though it seemed almost an ideal season climatically for growing cotton the mean yield per acre for the province works out at about the same as for the previous season ·36 bales per acre planted, or 144 lb. lint per acre. As will be mentioned later there was in many areas very heavy bollworm loss. A yield of ·45 bales per acre—nearly achieved in 1948—should have been possible without this loss, 180 lb. lint per acre; this would have allowed of a Provincial crop of over 150,000 bales. The general standard of timely planting and reasonable cultivation was rather better than in some recent years. The extent of the American bollworm loss is illustrated by Ukiriguru and district plot results discussed in the appropriate sections. In the circumstances, a baleage of 120,000 is considered very satisfactory. The dressing with "Perecot" of all the cotton seed for planting must have played a part by reducing blackarm loss.

Again this season cropping in the marginal fringe areas around the established Lake Province cotton growing areas was unsuccessful, mainly because of pest damage. A start is to be made this present season in attempting to control pest losses in these and other areas by insecticide spraying, based on Urambo and Eastern Province experience. In Tanganyika, insecticide use may be the big step forward to increased cotton growing productivity.

There are reports of considerable timely planting for the 1956-57 season.

SUMMARY OF THE MAIN RESULTS

The general trend of husbandry results at Ukiriguru and Lubaga have been as reported for previous years—responses to cattle manure, direct and residual, to phosphate, direct and residual, and to top-dressed nitrogen, showing substantial interactions with phosphate. Resting crop responses continued much as in previous years.

Recommendations that can now safely be made in these sand areas are: to use to the full any cattle manure available, with the knowledge that responses will continue for a considerable number of years. If cattle manure is not fully available, apply phosphate, 100 lb. per acre double superphosphate, again in the knowledge that residual responses will persist for a number of years. In addition top-dress with sulphate of ammonia at the time of cotton flowering, 100 lb. per acre—but this is for the year of application only and must be repeated each year. Any land-resting that is possible is equivalent to a dressing of cattle manure in direct and residual responses.

Apart from the UK. 55 multiplication, UK. 51 covered the whole Province.

UK. 55 grown on Kome Island on first multiplication gave 49 tons of seed for distribution this 1956-57 season from the two tons supplied from Ukiriguru in October, 1955—a multiplication rate of 24·5.

MZ. 561, compared to UK. 51 in the major trials at Ukiriguru, Lubaga, and district plots, yielded 93 lb. lint per acre less, 78 per cent of the UK. 51 yield, 91 lb. lint per acre less, 68 per cent of the UK. 51 yield, and 58 lb. lint per acre less, 82 per cent of UK. 51 yield, respectively. Some of the strains tested were significantly below the level of UK. 51, but only one strain in one trial was this season significantly better.

The cropping habits of 0/334 and 1/667 (the components of UK. 55) compared to MZ. 561, UK. 48, and UK. 51 are discussed. They have larger bolls and higher lint indices. The segregates from these and other top strains for the characters of lint index, percentage seed coat damage, and lint length, continue to be tested. The Albar 51 and B_2Bm crossing programmes continue.

The general impression this season has been that the dressing of UK. 51 seed with "Perecot" has kept in hand, in a year when bad blackarm might have been anticipated, the blackarm phase of *Xanthomonas malvacearum*.

On Ukiriguru, a strain with known insufficient resistance, in spite of the seed having been acid-treated, showed substantial loss from blackarm.

In many areas, including Ukiriguru, there was loss from bacterial boll rot. This was especially bad in the Musoma district. All seed for planting had been treated with "Perecot".

The outstanding feature of the season has been the loss of crop in late March and in April from bollworm attack—predominantly American, but, in areas Spiny attack has also been quite serious. On Ukiriguru American bollworm damage varied from complete destruction to a pernicious nibble.

GENERAL ACCOUNT OF THE WORK FOR THE SEASON

By J. E. Peat *and* K. J. Brown

Husbandry

Time of Planting.—Each year it becomes more and more evident that one of the biggest contributions to cotton productivity in the Lake Province is

timely planting. Allowing for the fact that too early planting results in boll-opening in late April—early May, when heavy rains may be expected, planting in late November, through December, is recommended. Land may still be prepared for planting late in October and through November.

Table 1 shows comparative yields in a time of planting trial at Ukiriguru this past season. The level of yields is on the low side; probably due to American bollworm damage. In the further section of Table 1 there are yield comparisons from the main, delayed, and late, times of planting at district plots. In some plots for various reasons the land preparation was later than is desirable. These were simple comparisons, not replicated, but, by reason of there being twelve, provided a reasonable measure of the effects of delayed planting.

TABLE I

TIME OF PLANTING

Yields: Seed cotton lb. per acre

UKIRIGURU Time of Planting Trial		District Observation Plots						
Planting date	Earliest time of Planting for the year	Late Dec.	Early Dec.	Mid Dec.	Early January	Early January	Mid Dec.	Mean of 12 District Plots
		Shigala (Nassa)	Ragata (Ukerewe Mainland)	Arugongo (Geita Shore)	Mabuki (Kwimba	Lagana Butulwa (Shinyanga)		
Early November... ... 814	Earliest	923	1,315	1,016	1,411	971	727	992
Early December... ... 594	Delayed	792	753	1,078	522	222	448	666
Early January 439	Late	535	583	339	47	82	283	348
Early February 318								
Sing. Diff (P=.05)								

Land Resting.—The results following the second cycle of "tumbledown" and planted treatments, Trial (6), are shown in Table 2. Following this second cycle of three-year rests, in the second year of cropping, seed cotton yields were similar to yields after continuous cropping, where compost at 3 tons per acre is applied every fourth year.

TABLE 2

MANURIAL AND RESTING CROP TRIAL

Ukiriguru—Hill Sand—Trial (6)

6 blocks (cotton) of 5 plots of 1/27·3 acres.

Cropping rotation—3 years fallow and millet: 3 years cotton. Compost applied 27th September 1954 (also in 1948 and 1951). Phosphate applied 27th September, 1954 (also in 1948 and 1951).

Cotton planted 21st November, 1955

Second year of the second cropping cycle	Second indicator crop of the second cropping cycle. Seed cotton lb. per acre
A. Continuous cropping with millet in the resting cycle, cotton in the cropping cycle:	
Control	416
Compost—3 tons/acre	692
Double superphosphate—75 lb. per acre	608
B. "Tumbledown" fallow	707
Planted fallow	695
Sign. Diff. (P=·05)	157
S.E.	±53·5

In Trial (7) the resting treatments were down for five years; in the fourth year of cropping on the first cycle the cotton portion showed non-significant differences between treatments and control. In the millet portion significant differences still showed following the compost dressing four seasons before and following two of the planted fallows which had been undersown with legumes.

The one-year resting trials were discussed in last year's report. This last season variants in one series were carrying first residual crops, and in the second series first indicator crops. Yields were very low and errors were high.

In Trial (31), first residual cropping with no phosphate, the highest increase was where velvet beans had been the one year rest. There, a seed cotton yield of 426 lb. per acre was obtained compared to the control of 283 lb. per acre. Where phosphate had been applied either for the 1954 resting season or for the 1955 cropping season, the increases were following the "tumbledown" fallow, or the planting to velvet beans, or where the millet had been undersown with legumes.

In Trial (36) first indicator cropping, where phosphate had not been applied, there was a general response where the millet had been undersown with legumes, and where the resting crop had been velvet beans. The highest yield was following the one year "tumbledown" fallow, 459 lb. seed cotton per acre compared to the control of 245 lb. per acre. Where phosphate had been applied, either for the 1955 resting season or the 1956 cropping season, yields increased from the control of 254 lb. per acre to just over 360 lb. per acre as a result of the phosphate dressing. The variants under velvet beans and undersown legumes did not show increases as a result of the phosphate applications over control plus phosphate; the top mean yield was "tumbledown" fallow plus added phosphate, 510 lb. seed cotton per acre.

The general story seems to be that there is minor profit from one year "tumbledown" rests, some profit in the growing of millet undersown with legumes; the major profit follows a "tumbledown" rest with phosphate added and that profit continues at least for two years.

At Lubaga there were no differential responses in the trials testing various land resting and rotation treatments.

Manuring and Fertilisers.

The classic Trial (8), discussed fully in earlier reports, growing the 12th indicator crop, was, under bulrush millet, generally less responsive to nutrient applications than cotton. Considering only the original application variants in the main trial, results were non-significant. For the 1955-56 re-applications, all treatment results were significant. As a result of applying sulphate of ammonia at 175 lb. per acre compared to the long-standing control a yield of 312 lb. per acre was raised to a mean of 525 lb. seed cotton per acre. The ash residual plots this year showed no increase over control; but applying sulphate of ammonia to a section of these the mean yield was raised to 775 lb. per acre.

The results from Trial (9) are set out in Table 3. This year, growing the third indicator crop in the third cycle of treatment, with sulphate of ammonia applied every year, there were continuing phosphate residual responses though not spectacular, and very good cattle manure residual responses—500 lb. per

acre increase from the straight cattle manure dressing. There were nitrogen responses with strong nitrogen/phosphate interactions. With a control of 775 lb. per acre seed cotton a yield of 1,722 lb. per acre was obtained from the highest applications.

There are undoubtedly residual benefits from earlier applications, for example, working on a cash-received basis, the value of the NP increase in seed cotton yield for the three years of the first cropping cycle of Trial (9) was Shs. 725/-. The value in the three years of the second cycle was Shs. 1,081/-. The seed cotton was valued at the same price.

TABLE 3

NPD Experiment

Ukiriguru—Hill Sand—Trial (9)

(Main plots) n_0, n_1, 0, 200 lb. sulphate of ammonia per acre.
Main plots split to give 2 × 3 factorial, testing all combinations of:—
(Sub plots) d_0, d_1, 0, 6 tons compost/acre.
p_0, p_1, p_2 0, 75, 150 lb. double superphosphate/acre.
6 replications of 12 plots, each 1/69·7 acres. Compost and phosphate applied 15th and 16th September, 1953, (also in 1946, 1947 and 1950). Nitrogen applied 14th February, 1956. Cotton planted 14th November, 1955.

Second Residual Year of Third Cycle—Nitrogen Re-Applied

Mean yields: Seed cotton lb. per acre

	(1)	d	n	nd
p_0	775	1,296	999	1,477
p_1	1,016	1,241	1,296	1,665
p_2	932	1,416	1,427	1,722
Sign. Diff. (P = ·05)				
in the same half of the table ...			183	
in different halves			261	

Interactions		
	NP_2 + 99	ND — 15
S.E.	± 45·9	± 37·0

The results from Trial (26) are given in Table 4. These are yields from the first indicator crop in the second treatment cycle. As with Trial (9) based on a three-year cropping programme with reapplications of phosphate and cattle manure, some residual benefits from the preceding cycles would be expected. The phosphate yields are on the low side, the cattle manure yields around what is normally expected. There are direct nitrogen responses, but, as in other experiments, the interesting responses are the interactions between nitrogen and phosphate. The control of 584 lb. seed cotton per acre is raised to 1,189 lb. seed cotton per acre, with the highest applications.

TABLE 4

NPD Experiment

Ukiriguru—Hill Sand—Trial (26)

replications of 2 × 2 factorial, with split plots of 1/69·7 acres giving 4 nitrogen treatments. Compost and phosphate applied November, 1955, also 1952 Sulphate of ammonia applied 16th February, 1956 at flowering.

p_0, p_1 0, 150 lb. double super phosphate per acre
d_0, d_1 0, 6 tons compost per acre.
n_0, n_1, n_2, n_3, 0, 50, 100, 200 lb sulphate of ammonia per acre.
Cotton planted 25th November, 1955.

FIRST INDICATOR YEAR OF SECOND CYCLE—NITROGEN RE-APPLIED

Mean yields: Seed cotton in lb. per acre

Nitrogen treatments	First indicator crops from dressings of compost and phosphate			
	(1)	d	p	pd
n_0	584	1,007	704	1,063
n_1	788	1,277	943	1,226
n_2	795	1,308	1,036	1,230
n_3	811	1,381	1,189	1,439

Sign. Diff. (P= ·05)

in the same column	165
in different columns	259

Interactions

S.E. ...	N_3p + 65 ± 29·1 / N_3D + 10 ±29·1

The results from Trial (38) are set out in Table 5. This trial was designed to get response curves, using three rates of double superphosphate and nought, and three rates of sulphate of ammonia and nought. Last season no worthwhile yield differences were obtained. This 1955-56 season first residual responses have appeared. With a fairly high level of soil fertility, straight nitrogen responses show up, no phosphate responses, but, again, satisfactory nitrogen/phosphate interactions.

TABLE 5

NP EXPERIMENT

Ukiriguru—Hill Sand—Trial (38)

4 × 4 factorial with N'' P''', N''' P'' and N''' P''' interactions partially confounded, testing all combinations of:—

n_0, n_1, n_2, n_3 0, 50, 100, 200 lb. sulphate of ammonia per acre.

p_0, p_1, p_2, p_3 0, 45, 90, 150 lb. double superphosphate per acre.

6 replications in 12 blocks of 8 plots, each 1/69·7 acres. Phosphate applied 21st December, 1954. Nitrogen applied 15th February, 1956. Cotton planted 22nd November, 1955.

FIRST RESIDUAL YEAR OF FIRST CYCLE—NITROGEN RE-APPLIED

Mean yields: Seed cotton in lb. per acre

Nitrogen treatments	Second indicator crop from dressings of phosphate			
	P_0	P_1	P_2	P_3
n_0	968	971	1,065	1,029
n_1	1,178	1,429	1,242	1,151
n_2	1,204	1,258	1,344	1,500
n_3	1,246	1,517	1,254	1,549

Sign. Diff. for all comparisons (P= ·05) 183

Interactions

S.E. ...	N_3P_3 + 121 ± 32·7

The general summing up is that there should be the fullest use of cattle manure. Where cattle manure is insufficient, phosphate should be applied and nitrogen top-dressed at the time of flowering in February. A few years ago, following a droughty March, some doubts were expressed as to the advisability of African growers using nitrogen, but the results of the last few seasons have been so striking in the profit accruing from the use of nitrogen that progressive growers cannot afford not to use it. Its use is now strongly recommended where phosphate or cattle manure is also used, in other words where there are a sufficiency of phosphate and probably other nutrients to make the application worth-while. There is a very worth-while nitrogen phosphate interaction. The profit is for the year of application only and there may be occasional years when the profit from application is reduced. (The mean March rainfall over a period of 25 years has been 4·75 inches. March droughts are unusual).

Ridge Tying.

In the Ukiriguru Trial (16) there was for cotton a small but significant increase in yield as a result of tying, an increase to 1,137 lb. seed cotton per acre compared to a non-tied yield of 1,076 lb. per acre. Differences in the millet section were not significant.

At Lubaga there was a heavy American bollworm attack in March which distorted most of the experimental results. In the one ridging trial under cotton there were no significant differences between 3 ft. planting on the flat, 3 ft. tie-ridged, and 4 ft. tie-ridged. In the second "ibambas."* trial, also under cotton, with a high error, the 3 ft. tie-ridged planting gave nearly 50 per cent more than the 3 ft. flat planting. In the sorghum portion of this trial, using Dobbs sorghum, 3 ft. planting on the flat gave a mean of 315 lb. per acre, 3 ft. tie-ridged a mean of 799 lb. per acre, and 4 ft. tie-ridged a mean of 873 lb. per acre. On the "ibushi"† trials, both for cotton and sorghum, yields were similar with flat planting, 3 ft. ridging and 5 ft. ridging; but there was a reasonable increase over flat planting where the ridges had been tied.

In a trial at Ukiriguru, comparing 3ft., 4ft., and 5 ft. ridging, tied, with cotton and bulrush millet as the indicator crops, no yield differences showed up, nor on a field scale test—in spite of a season of above average rainfall—did 3 ft. ridging break as was feared.

Cotton Breeding

Of the three cotton breeding programmes two are concerned with breeding for resistance to bacterial blight. These are discussed in the bacterial blight section.

With the exception of the multiplication of UK. 55 in Kome Island, the whole of the Province was under UK. 51 in the 1955-56 season. For the 1956-57 season 450 tons of UK. 51 have been sent to the Coast Province, Kenya, and 220 tons to Nyanza Province. UK. 51 is also grown in parts of Tanga Province in Tanganyika. On Kome Island two tons of seed of UK. 55 were planted. There was a multiplication rate of 24·5 times; 49 tons of UK. 55 are available for planting this 1956-1957.

*cemented hard pan soil.
†old lake-bed calcareous loam.

UK. 51 lint is commented upon as inherently satisfactory by spinners using it—apart from some unsatisfactory admixture in seed cotton and some extraneous matter in baled lint. There is a growing understanding of the variations in quality that occur between the better Lake shore areas and some of the poorer inland areas.

In the Ukiriguru Main Strain Trial, yields were up to 1,350 lb. seed cotton per acre. There was American bollworm loss in this trial. MZ 561 yielded in lint 78 per cent of the yield of the control UK. 51. There was no yield difference between UK. 51 from seed continuously grown at Ukiriguru, and UK. 51 grown from commercial seed stocks. UK. 51 in this trial ginned 1·3 per cent higher than MZ. 561. It would appear that UK. 55 will have a slightly higher ginning percentage, and a higher lint index, than UK. 51. Some of the strains in the trial were significantly down on UK. 51, but this year none was superior. UK. 55, 0/334, 0/328 and 1 667 were all around the control yield level, but with higher boll weights and higher lint indices. The question of boll size relative to boll worm damage requires thought.

In the Lubaga Strain Trial, MZ. 561 yielded lint at 68 per cent of the UK. 51 level. The mean of the 12 district plots showed MZ. 561 yielding, in lint, 82 per cent of the UK. 51 level, again there were no significant differences between UK. 51 seed multiplied at Ukiriguru, and UK. 51 from commercial seed stocks.

Taking the district plots as a whole the increased ginning percentage of UK. 51 compared to MZ. 561 was only ·5 per cent.

In some study of the cropping habits of MZ. 561, the earlier issues, and 8/290 segregates, it would seem that the early cropping is not very different. It is around early June that 8/290 and the daughter strains start yielding substantially more in picking. (For example, in 1955, 0/328 in a picking in the third week in June, yielded at the rate of 540 lb. seed cotton per acre compared to the 240 lb. per acre for MZ. 561. The other daughter strains from the 8/290 family behaved in a very similar fashion). UK. 51 approximates more to the 8/290 style of cropping than do the earlier issues. This heavier cropping later in the season is part explanation of the higher yields; but there is always greater possibility of insect and disease damage to the later produced crop.

There will be more intensive study of the variations in cropping. On a station such as Ukiriguru it has not always been possible to time the picking intervals exactly the same from year to year; but to serve this study a more precise picking programme will in future have to be arranged. This last season when the crop was picked in four pickings and had been reduced by American bollworm attack, the general cropping behaviour has been similar to the cropping of 1955.

A most interesting result showed at Ukiriguru. A fertiliser trial, planted on the 22nd November, first residual for phosphate rates, nitrogen reapplied, had six replications. The land was in good heart and growth was uniform. Two replications were planted to the strain 8/290, and two to the daughter strain 0/328. Two replications were planted to a strain 0/457, ex 7/367 ex originally Lubaga 4/112, a good yielding representative of this family in most years; but in some earlier years 7/367 was suspected as not having much

resistance to blackarm, whereas the view is growing that the 8/290 family has above average resistance. All seed had been acid-treated making it equivalent to bactericide dressed seed.

The extent of blackarm on the 0/457 replicates compared to the 8/290 and 0/328 replicates, was striking throughout the season. The final yield results are as follows :—

Yields lb. seed cotton per acre

	8/290	0/328	*Adjacent replications* 0/328	*Adjacent replications* 0/457	0/457
Mean yields/acre—all treatments ...	1,332 ...	1,392 ...	1,385 ...	920 ...	1,005
Mean yields of controls (no phosphate or nitrogen)	1,065 ...	1,161 ...	1,037 ...	645 ...	679
Mean yields highest applications of phosphate and nitrogen	1,816 ...	1,799 ...	1,782 ...	1,054 ...	1,032
% Grade C	16% ...	16% ...	— ...	— ...	22%

Why there should have been such a heavy attack under these particular conditions, to a partially susceptible strain, using acid-treated seed, when the Province as a whole suffered comparatively little, is not understood.

Single plant selections had been taken in 1955 in some of the best Ukiriguru lots, more especially daughter strains of 8/290; further selections were taken in 1956. Little habit variation can be seen in the field. Selections all had reasonable cropping habit and generally good leaf hair. In multiplication this last season discarding was done in the 1955 selections for insufficient leaf hair; and they were all grouped for lint index, seed weight, ginning percentage, percentage seed coat damage, and for lint length. There were, as has been recorded in other years and in other territories, considerable variations in these characters from area to area and through the cropping season. As an example, between two pickings a month apart in 0/334, there was a difference in boll weight of 10 per cent. The same strain grown under different conditions at various district plots showed ginning percentage variations of 31·6 per cent to 36·6 per cent, lint index differences of 4·2 to 5·5, seed weight differences of 8·7 to 10·4 grammes per 100 seeds, seed coat damage percentage differences of 12 per cent to 39 per cent. There are variations, on Ukiriguru itself, between early and late pickings and cotton grown widely spaced on good land and commercially spaced on poor land.

Comparing the records made in 1955 on the single plants, and the records on the progenies in 1956, it may be said that "high field" for any particular character tends to be "high field" in the succeeding year. Similarly, "low field" in any character tends to be "low field" in the succeeding year, but the mass of material in the middle groupings in the second year may go either way. The 1955 selections are now in trials for the 1956-57 season, and the 1956 selections are in simple replicated layouts as well as in small multiplication bulks.

The idea is that the bulks will supply multiplication material for trials and bulking in 1957-58. The simple replication will allow more accurate laboratory testing—without any thought of yield comparisons at this stage from such replication.

In seed grown at Ukiriguru, MZ 561 showed 14 per cent of naked seeds, UK 48 3 per cent, UK 51, both from Ukiriguru grown stocks and ex commercial stocks, nil, and UK 55, nil.

DISEASES

By M. H. Arnold

Bacterial Blight (Xanthomonas malvacearum)

General.—The most striking feature of the disease this season has been the widespread occurrence of serious bacterial bollrot. In the three previous seasons bacterial bollrot has not, in general, caused severe losses : in most areas, although the incidence has been high, the damage done has appeared slight, lesions being typically restricted to the base of the boll and causing staining of the locule tips only. This season, however, bacterial bollrot has caused widespread loss of bolls and damage to lint; large water-soaked lesions on boll walls have been of common occurrence in addition to lesions spreading from the base of the boll.

Seed treatment seems to offer little protection against this phase of the disease and it would appear that complete control will be achieved only by breeding for resistance. Even if seed borne infection could be reduced to negligible proportions by more efficient seed disinfection, there is still the problem of trash infection against which it would be very difficult to effect control measures in the province at large.

Hybrids Resistant to Bacterial Blight.—The importance of bacterial bollrot this season has served to focus attention on breeding for resistance to this phase of the disease. An easy and effective technique for large scale boll inoculation is badly needed, however, and tests on new techniques are being carried out in collaboration with Mr. Logan of Namulonge.

In the Albar 51 programme, backcrossing was discontinued at the end of last season when fourth backcrosses had been made with the best existing Ukiriguru strains. Selections from these crosses, together with selections made at earlier generations are now being tested. Of 52 lines included in yield trials this season, the majority did not differ significantly from UK 51 whilst three yielded over 20 per cent higher (Sig. at P ·05) and one over 30 per cent higher (Sig. P ·01). These latter were all derivatives of first backcrosses and closely related to similar lines noted as high yielding in the previous season's trials.

Fifteen single plant progenies and UK 51 were grown in replicated plots measuring 5 feet by 7 feet 6 inches, giving 10 stands per plot at normal spacing. The layout employed was a 4 × 4 Balanced Lattice Square (5 replications). The mean yield of seed cotton harvested was 1,125 lb. per acre with a coefficient of variation of 22 per cent; there were fertility irregularities in the trial and there were losses due to Lygus and American bollworm attack. Lint and seed characters of the selections included in this trial have not yet been studied. It is hoped that in future seasons information from such replicated progeny rows may be utilized to give a worthwhile assessment of yield in the first year after selection.

Although little is at present known about the status of the Albar 51 hybrids with regard to their resistance to bollrot, observations from natural infection indicate differences in the degree of boll resistance between individual lines. Hence it may be possible to build up resistance by selection in this material.

The crossing programme with BAR 13/38 (B_2B_{6m}) was continued, first backcross plants being grown "in season" and second backcross plant "out of season" under irrigation. Amongst the latter were some plants with high jassid resistance and a marked improvement in plant habit. These have been further backcrossed to the best Ukiriguru strains and some have also been selfed. Immunity to stem and leaf attack appears to have been retained by inoculation and rigorous selection. In the coming season as much of this material as possible will be boll inoculated and, if practicable, breeding continued only from plants which show immunity to all phases of the disease.

Resistance in Strains of Local Origin.—Observations in past seasons in non-replicated plots have indicated differences in the degree of susceptibility to stem inoculation between strains of local origin. 8/290, from which the present highest yielding Ukiriguru strains have been selected, has consistently shown some resistant plants, whilst 4/53 has been noted for its high susceptibility.

In a replicated test this season, these two strains were compared with Albar 49 for their reaction to stem inoculation. The results, which are summarized below, reveal that 4/53 is almost completely susceptible whereas in 8/290 some 60 per cent of the plants showed a high degree of stem resistance.

When tested at Shambat in 1957 by Hutchinson, using a leaf-spray inoculation technique, 4/53 was found to lack B_2 whilst this gene was present in the parental stocks from which 8/290 was subsequently selected. Wickens and Logan conclude, from tests made on other strains at Namulonge, that B_2 confers virtually no stem resistance in *hirsutum* as indicated by the needle prick technique. Though conditions in the Lake Province are different from those at Namulonge and it may be that response to needle prick inoculation does not always follow the same pattern in both areas, the difference between 4/53 and 8/290 is so marked as to suggest that genetic factors other than B_2 may be involved.

TABLE 6

Percentage distribution of plants after grading for reaction to stem inoculation

	Reaction grade					
	0	1	2	3	4	5
Albar 49	62·2	35·4	2·2	0·2	0	0
8/290	12·7	48·8	28·6	8·5	0·8	0·6
4/53	0·5	1·4	16·6	56·5	17·8	7·2

Key to grading:
0 Complete callus; no infection.
1 Incomplete callus and/or trace of infection.
2 Fair callus; definite lesion.
3 Slight callus; spreading lesion.
4 No callus; severe spreading lesion.
5 No callus; main axis and growing point killed.

Design: Randomized Blocks (16 replications).
Spacing: 2 rows per 5 ft. ridge at 18 ins. within the row, thinned to 2 plants per hole.

Planted: 15.12.56.

Inoculated: 11.2.56.
Scored: 17/23.4.56 (average number of plants scored per variety = 479).

It is hoped that more local strains may be tested in the coming season with a view to elucidating to what extent there has been selection for bacterial blight resistance during the course of the original breeding programme.

Seed Treatment.—In view of the better results consistently obtained from mercurial seed dressings as compared with copper formulations, attention has been given to the possibility of using mercurials on a large scale in the province. The main objection to their use is the risk of poisoning, both to the labourers who operate the seed-treating machines and as a result of the misuse of treated seed. It was felt that a seed dressing, which imparted a distinctive colour to the seed, would help to alleviate the latter risk. To this end, several manufacturers have supplied modified formulations of their seed dressings, which incorporate additional quantities of dyes. Some of these when applied at the normal rate of 1 : 300 w/w; impart an adequate colour to the seed and tests of primary infection made on 21-28 day old seedlings, showed that the addition of dyes had made no difference to the effectiveness of the dressings.

The large scale use of mercurials is not envisaged for the immediate future. There must be further investigation into the dangers to which unskilled labour would be exposed in the dusting sheds, before the use of mercurials can be fully supported.

Measurements of yield in both observation plots and replicated trials did not consistently show increases in yield due to seed treatment. In the main trial where untreated seed was compared with Agrosan-treated and Perecot-treated seed in four 3 × 3 Latin Squares, there were spectacular differences in the general appearance of untreated and treated plots during the first three to four months of growth. Scores of seedlings at 21 days after emergence and shown 94·3 per cent with cotyledonary lesions in the untreated plots compared with 13·5 per cent for Perecot-treated and 5·2 per cent for Agrosan-treated.

Most of the early fruiting points in this trial were lost, however, owing to an infestation of Lygus and later there were losses from bacterial bollrot with some loss from American and Pink bollworm. Where yields of the order of 800-1,000 lb. per acre seed cotton might reasonably have been expected from the treated plots, the mean yield harvested was 335 lb. per acre of which 70 per cent was Grade "C". (The mean yield for the untreated plots was 306 lb. per acre; the increase of treated over untreated of 29 lb. per acre or approximately ten per cent was not statistically significant). Such severe losses of bolls are rarely experienced at Ukiriguru. The heavy pest attack is thought to have resulted from a build up of Lygus and American bollworm on some eight acres of early planted sorghum which was growing nearby.

Following last season's observations on the importance of lesions at the cotyledonary node, detailed observations were made on samples of 150 square feet in all plots in the trial mentioned above. Immediately upon uprooting, the plants were graded according to the severity of lesions at the cotyledonary node and the fresh-weight of each class measured. Later the numbers of plants and bolls were recorded.

TABLE 7

SEED TREATMENT TRIAL, NGEREJA III

Scores of plants from sample plots

Design: : Four 3 × 3 Latin Squares. *Plot sizes:* 0·0367 acres (total); 0·0034 acres (sample); 0·0135 acres (harvested). *Spacing* : 2 rows per 5 ft. ridge at 18 ins. within the row, and 2 plants per hole.

Planted : 20/21.1.56 *Scored:* 12/14.5.56 *Harvested:* 5.7.56 and 24.7.56.

Treatment		*Lesion grade at cotyledonary node*						Total plants	Total bolls	*Yield, seed cotton lb./acre*	
		0	1	2	3	4	5			Predicted from boll number	Recorded in remainder of trial
Untreated	P	31	69	164	142	77	85	568			
	W	9·00	8·91	6·37	4·87	1·64	1·12				
	B	7·10	7·09	5·30	3·95	1·35	0·80		2,311	580	306
Perecot 45 1:300w/w	P	354	189	121	76	22	41	803			
	W	5·93	5·35	3·19	3·58	1·18	1·05				
	B	3·93	3·65	2·73	2·25	1·14	0·76		2,638	660	330
Agrosan GN5 ... 1:300w/w	P	479	192	105	43	9	10	838			
	W	5·38	4·71	3·65	3·09	1·11	0·80				
	B	2·90	2·81	2·46	2·44	1·00	0·60		2,308	580	339

Key:

P = No. of plants (totals of 12 samples).
W = Fresh-weight per plant (ozs).
B = No. of bolls per plant.

Key to lesion grades:

0 = No infection.
1 = Trace of infection.
2 = Definite lesion.
3 = Spreading lesion.
4 = Severe spreading lesion.
5 = Main axis killed, growth continuing by shoot from one or both cotyledonary buds.

The data which are summarized in Table 7 show that lesions at the cotyledonary node are associated with suppression of plant growth but there is interaction of plant growth with treatment effects. There may have been differential losses in the early stages as a result of Lygus attack, but the higher figures for plant fresh-weight and bolls per plant in the untreated plots, can be partly attributed to increased growth by the more healthy plants as a result of loss of stand and of the suppressed growth of plants with severe stem lesions.

The differences between the last two columns in Table 7 are attributable, apart from sampling errors, to loss of bolls from all causes subsequent to the time of scoring. Scores of bacterial bollrot, made at the same time as the other observations, indicated that the incidence of this phase of the disease was not related to seed treatment. There may have been spread of infection from plot to plot and since cotton had been grown on the same site for two successive seasons, there may have been infection from trash. It is thought, however, that in the treated plots, the residual seed-borne infection could have provided inoculum for the later built up of bacterial bollrot.

Wilt.—Fusarium oxysporum f. *vasinfectum*.—There were sporadic occurrences of wilt in the same areas in Geita District where the disease has been noted in previous seasons. More patches were observed than last season.

but it could not be determined whether this was due to spread of the disease or to further discoveries of diseased patches as a result of more extensive searching. The localities of known occurrence of the disease have been sealed off from the seed multiplication area by the Department of Agriculture. Three sites have been chosen for testing imported wilt resistant strains of cotton in the coming season.

PESTS

By J. E. Peat

American Bollworm.—Very serious loss was caused throughout the province by American bollworm attack. From late March into April there were examples of bad attacks on Ukiriguru itself and in the area around. There were heavy attacks in the Musoma District, Ukerewe District, Ukerewe Mainland, Nassa and Geita, resulting in a heavy loss of crop. Some later recovery occurred in some areas, but only partially so.

The loss caused is illustrated by the yields at two of the best district plots, Suguti in Musoma District, and Lagata in Ukerewe Mainland, where there had been heavy American bollworm attack on very well grown cotton. The Suguti plot in 1955 gave a mean yield of 2,293 lb. seed cotton per acre. The mean yield this last season was 811 lb. per acre. Similarly, at Lagata, in 1954 the mean yield was 1,949 lb. seed cotton per acre; in 1955 the mean yield was 1,683 lb. per acre; this last season a magnificently grown crop yielded 1,166 lb. per acre. There had been some recovery but, as a result of the late crop, 37 per cent was Grade "C" compared to 7 per cent in 1955.

On Ukiriguru the "mbuga" (valley bottom) Strain Trial was free from American bollworm in mid March; by mid April the entire crop had been destroyed; recovery was to all intents and purposes, nil. From past experience this style of crop on the "mbuga" could give yields of 1,500-1,800 lb. seed cotton per acre. The belief is that American bollworm populations bred up nearby on early planted, early-maturing sorghum, and that it was a generation from this that completely destroyed the cotton trial. There was loss elsewhere on the Station which it was thought could mainly be attributed to plantings of early-maturing sorghum. It may be that other influences are involved. The need for entomological study is very real.

As regards the peoples' cotton, the hypothesis is that with favourable early rains they planted areas of early maize—more than in most years—and that it was the breeding-up on this maize which produced in the next generation the populations that later attacked cotton. It is in areas where maize is grown as a main crop that the damage is always greatest. In North Mara, for example, where maize is an important cash crop but where the people very much want also to grow cotton because of falling maize prices, a fair acreage of cotton grown as a test was almost completely destroyed by American bollworm. In contrast to this on an island adjacent in Mara Bay where only cotton had been planted the yield was very satisfactory.

Following the successful results of control at Ilonga and Urambo, an experimental start is to be made this 1956-57 season in the control of American bollworm, and other pests by the use of insecticides. The practical

administrative problems involved in the widespread use of insecticides amongst African growers, are difficult; but the first step is to demonstrate what control can be effected and at what cost.

From Ukiriguru experience it would seem that the breeding up of American bollworm populations and the transfer to cotton come from crops fairly reasonably adjacent; for example, it is not thought that there is a movement from "mbuga" sorghum to hill cotton—a matter of a mile or more. The arrangements for this season are that the Botanist has priority on the "mbuga" and cotton there, if need be, must be treated with insecticide if American bollworm attack develops. On the hill, cotton has the priority : the Botanist's nursery is to be sprayed, and his hill sorghum, at the far side of the Station is not to be planted until late January.

Spiny Bollworm.—Spiny bollworm damage was of only minor importance on Ukiriguru, where the practice is to uproot continuously throughout the season *Hibiscus* and other *Malvaceous* weeds. In some districts, for example Musoma, there was considerable damage from Spiny bollworms. It is supposed that these are bred up on the considerable populations of *Hibiscus*, probably especially plentiful in a season of well-distributed rains. The suggestion has been made that communities keen on cotton growing should try to slash down these *Hibiscus* hosts throughout the season.

Pink Bollworm.—Pink bollworm was not a serious pest. The apprearance of Pink bollworm from time to time is a reminder that a rigorous close season is essential. On Ukiriguru itself at harvesting, Pink bollworm were to be found and in some plots reduced the yield from late-formed bolls; on Ukiriguru this is probably a carry-over from the out-of-season breeding programme. In early July in all parts of the Station there were Pink bollworms in the late bolls.

Stainers.—It was not a bad stainer year, though by late June, on Ukiriguru, there were considerable stainer populations, which reduced the chance of getting worth while top crops. In a count in late June, 76 per cent were *D. fasciatus*, 11 per cent *D. nigrofasciatus*, 7 per cent *D. superstitiosus* and 6 per cent *D. cardinalis*.

Lygus.—There was Lygus attack in various areas, especially following American bollworm damage. There was Lygus damage in the Ukiriguru "mbuga" following the American bollworm attack already described. In Mr. Arnold's seed dressing trial planted in mid January—intentionally slightly on the late side—there was crippling Lygus attack; this is attributed to a movement of Lygus from early-maturing, early planted, ripening sorghum nearby. The trial cotton must have been highly attractive at the time of this movement. An NPD cotton trial lying between the sorghum and the attacked cotton, early-planted and tough at the time of the Lygus movement, escaped all damage, the top plots yielding up to 1,700 lb. seed cotton per acre.

APPENDIX

Origin and Special Characteristics of the Main Cotton Strains Mentioned

Lake Province "Local"	The commercial cotton in the Province prior to the issue of MZ 561—mainly of Uganda Local Origin.
MZ 561	A straight selection from "Local", first multiplied in the 1939-40 season.
UK 51	A seed issue made up of seven strains with jassid resistance, first multiplied in the 1951-52 season.

4/53 A derivative of MZ 561 lacking B_2.
7/367 Ex Lubaga L4/112, ex originally MZ 457.
0/457 Ex 7/367.
8/290 Ex 6/320, one of the heaviest cropping Ukiriguru strains—Ex 4/35.
0/328, 0/331, 0/334, 1/667 } Ex 8/290.

Albar Nigerian Allen (-Al) blackarm resistant (-bar) selections made at Namulonge. Two series of selections were made independently, Albar 49 in 1949 and Albar 51 in 1951.

BAR 14/38 B_2B_2m Sakel ex Shambat.

SOIL CHEMISTRY

By P. H. le Mare and A. M. Kabaara

Mr. Kabaara spent six months at Namulonge studying methods of soil analysis. He returned to Ukiriguru in September, 1956, when equipment for the laboratory arrived.

Investigation of the quantity, position and movement of nitrate in the Hill Sands at Ukiriguru has been started. Soil samples, down to 66 inches, are being taken at fortnightly intervals throughout the season 1956-57.

A study of the moisture status of the Ukiriguru soils has commenced. The methods developed by Farbrother at Namulonge are being used.

The effect of land resting and organic manures on the supply of nutrients in the Hill Sands is also being studied.

PLANT BREEDING

Ukiriguru Rainfall—October, 1955 to September, 1956

Year	Month	Rainfall in inches	No. of days
1955	October	1·15	5
	November	3·73	7
	December	5·52	10
1956	January	4·38	10
	February	4·85	5
	March	4·93	8
	April	5·80	11
	May	4·52	4
	June-July	—	—
	August	1·17	3
	September	0·64	3
	Total	36·69	66

General.

The rainfall was well distributed and the season was a satisfactory one. Covered smut (*Sphacelotheca sorghi*) was rather prevalent, but Striga, borer, and birds, were no more serious than usual. An unusually large number of American bollworm larvae was present in the panicles of the earliest planted sorghum.

(A) *Sorghum Breeding.*—This work may be summarised under the following heads :—

(1) The development of better yielding early maturing varieties with high quality, weevil resistant grains.
(2) The attempt to obtain bird resistance by combining a pendant head (goose-neck) with large glumes, and awns.
(3) The attempt to develop Striga resistant lines by selection within Dobbs.
(4) The development of tetraploid varieties.

(1) *Early maturing varieties with high quality, weevil resistant grains.* SUK 1 did not show up very well this season, its main defect having been low yield. It has not always been given a fair chance, often being put in late when Central Shoot fly is present in large numbers; but there is no doubt that a higher yielding variety is required. Covered smut is also serious on SUK 1 : quite probably no more so than on introduced varieties such as Dobbs, but precise counts are lacking. The standard of cultivation apparently has a marked effect on the incidence of smut, as the following count from Kisangwa Farm, Musoma, shows :—

Percentage of Heads with Smut

	SUK 1	Enyanza	Local
Poor cultivation	39% ...	28% ...	1%
Medium cultivation	17% ...	19% ...	0%
Good cultivation	3% ...	2% ...	0%

(Enyanza is an introduction from Uganda, and the Local variety was a Bukura type).

These figures suggest that a good measure of smut resistance exists in the local variety, which needs to be incorporated in new varieties bred at Ukiriguru.

Of the two lines from the BC. 27 (2) × Wiru backcross mentioned in last year's report, 42B has proved to have the greater weevil resistance, and will probably be issued as SUK 2 if it shows up satisfactorily in the 1956-57 season's trials. It has the same high quality grain as SUK 1 and yields better, although it is slightly later maturing (a little over four months from planting to harvest). Yield figures from the district plot trials are shown in the following table :—

Yields in lb./acre of grain
District plot

Variety	Butulwa	Mwanangwa	Lubaga	Mean
Bukura Mahemba ...	380 ...	980 ...	1,950 ...	1,100
Dobbs	1,380 ...	1,600 ...	2,640 ...	1,870
B.C. 27	620 ...	1,370 ...	2,750 ...	1,580
SUK. 1	290 ...	820 ...	1,710 ...	940
36 D	450 ...	1,040 ...	2,450 ...	1,300
42 B	840 ...	860 ...	2,040 ...	1,250
LSD at P=0·05 ...	130 ...	230 ...	205 ...	—

Losses due to weevil in bulk storage tests were as follows :—

Wiru	4·6%
SUK. 1	9·3%
42 B	8·8%
B.C. 27	38·4%
L.S.D. (P = 0·05)	3·8%

The weevil resistance of both SUK 1 and 42B is certainly superior to that of BC. 27, although not quite as good as that of Wiru.

Line breeding of the B.C. 27 (2) × Wiru backcross has been discontinued, the remaining material being put into a panmixia. Closer attention is now being given to the B.C. 27 (2) × Msumbiji backcross: lines with extremely good grains which may have some resistance to grain moulds have been obtained, and while it is too early to be confident on the yield level, the material looks more promising than did that of the B.C. (2) × Wiru backcross.

200 lines from the Dobbs (2) × Wiru backcross were grown, and some appear to have good grains. It is important to keep Dobbs crosses in the programme, as this variety has a good measure of resistance to Striga, and is consistently high yielding. Its grain is poor, and it is very susceptible to covered smut, but these are its only real defects.

There is now a range of early maturing material available from crossing a number of late maturing varieties having very corneous grains with the early maturing varieties B.C. 27, Dobbs and Oklahoma 44-14. This material includes lines from B.C. 27 (2) × Wiru, B.C. 27 (2) × Msumbiji, B.C. 27 × Belko, B.C. 27 (2) × Belko, Dobbs (2) × Wiru, and Oklahoma 44/14 × Kabili. These have been mentioned in previous reports. This season, 28 crosses have been made between these lines in various combinations, and the F_1 generations grown out. Reserve seed has been kept to allow the F_1 generations being crossed together next year, so that combinations of the lines in groups of four can be made, i.e. (A × B) (B × C). The material has good or very good weevil resistance, and is all early maturing. It would seem that intercrossing at this stage is likely to offer better prospects of obtaining high yield coupled with good grain quality, which has proved a difficult combination to find. There should certainly be a much better range of variability than has previously been available.

(2) *Bird Resistance*

The crosses outlined below have been made with the object of obtaining the combination of good grain, goose-neck and large glumes. It will not be possible to assess the value of these characters in discouraging birds until the combination has been effected.

1953 Crosses Goose-neck × good grain

1954 Crosses (A) 1953 crosses × large glume
(B) 1954 crosses, group A, backcrossed to the 1953 cross parents.

1955 Crosses (A) 1953 crosses × good grain (B.C. 2 Wiru 36D and 42B)
(B) 1954 crosses, group B, × good grain (B.C. 2 Wiru 36D and 42B)

1956 Crosses 1955 crosses, group A, × 1955 crosses, group B.

The material in the above programme is derived as follows:—

Goose-neck B.C. 27 × Korgi, B.C. 27 × Ng'holongo,
Oklahoma × Kabili, Oklahoma × Korgi,
Oklahoma × Ng'holongo and B.C. 27 × Kabili.

Large Glume Feki Mustahi, ex Sudan

Good Grain Various lines of B.C. 27 (2) × Wiru.

This season, sixty-six 1956 crosses were made, excluding the intercrossing referred to in the first section of the report, and the F_1 generations were grown. So far, there are some promising lines showing the combination of goose-neck and good grain from the 1953 crosses, notably 53 × 44 and 53 × 47. Plenty of lines with large glumes have been obtained in the progeny of the 1954 × 1955 crosses, although it is too early to be sure whether the necessary combination with good grain is present. There was an encouraging number of goose-necks present in the F_1 generation of the 1956 crosses. It will be surprising if this series of crosses fails to yield the combination of good grain, goose-neck and large glume required.

Awns.—The main sources of awn are Belko (long but weak), and Nandayal Poona (medium length, but rather stiff). Awn lengths of 17-20 mms. were obtained in the B.C. 27 (2) × Belko lines, and 14-16 mms. in the B.C. 27 (2) × Nandayal Poona lines. Two intercrosses have been made, and others will be done to try and increase awn length and strength, but the prospects of obtaining an awn which will be a real deterrent to birds seem slender. The attempt should be made, however, and the awn may have a bigger contribution to make towards bird resistance when coupled with the goose-neck and large glume combination. The possibility of crossing in the long, strong awn of *Sorghum purpureosericeum* to the cultivated sorghum is being studied, but this is likely to prove difficult.

In this section, only the main lines of the work have been set out, for the sake of clarity, but various other crosses which may contribute useful material have in fact been made.

(3) *Striga Resistance*

Thirteen of the Dobbs progeny rows selected for Striga resistance in the field at a 6 ft. × 6 ft. spacing were bulked, and next season it should be possible to assess the progress that has been made in obtaining a greater measure of Striga resistance, by selecting for six generations on land heavily infested with Striga.

(4) *Tetraploid Sorghum*

For the past two years some time has been given to exploring the possibility that tetraploid varieties might be useful. Doubling with ·01 to ·02 per cent colchicine applied to the germinating seed when the plumule was around 2 cms. long proved satisfactory, and tetraploids were obtained from 3 lines. These were a strain of B.C. 27 (2) × Wiru, B.C. 27 (2) × Msumbiji and Oklahoma × Kabili. The tetraploid plants were rather stouter and shorter than the diploids, but the flowering date was not appreciably affected. Seed set was poor, 30·5 per cent in B.C. 27 (2) × Wiru (range 0-67·0), 30·7 per cent in B.C. 27 (2) × Msumbiji (range 18·4-48·2) and 17·0 per cent in Oklahoma × Kabili (range 4·9-33·2).

Crosses between these lines were attempted, but only one succeeded, that between B.C. 27 (2) × Wiru and B.C. 27 (2) × Msumbiji, labelled as 4N × 5. The F_1 showed a marked increase in fertility, and the F_2, from the F_1 plants with the highest set, appeared to show a further improvement.

Results are shown in the following table :—

Seed set as a percentage of the total sessile spikelets in the panicle

Class per cent set	BC 27(2) × Wiru	BC 27(2) × Msumbiji	Cross 4N × 5,F_1	4N × 5,F_2	Diploid
0— 9·9	4	—	—	—	—
10—19·9	3	3	—	2	—
20—29·9	3	7	—	0	—
30—39·9	6	5	1	2	—
40—49·9	1	5	0	1	—
50—59·9	2	—	5	3	—
60—69·9	2	—	13	6	—
70—79·9	—	—	18	17	1
80—89·9	—	—	—	33	10
90—99·9	—	—	—	—	9
Arithmetic Mean	31%	31%	68%	74%	88%

The F_1 and F_2 were vigorous plants, and the increased panicle and spikelet size, together with the larger grain size, give the impression of better yield, although this will be offset to some extent by the reduced seed set. Intercrossing and selection for higher fertility may well solve this difficulty, and twin grained types are also being brought into the programme, as a 75 per cent seed set with twin grains should result in very few empty spikelets. When only one grain is produced in the spikelet of a twinning variety, it is usually relatively large. The problem of getting the apparent fertility level of tetraploids back to that of diploids should not be difficult to solve along these lines. 20 new tetraploid lines were produced this season, and some seem to be very good, with large panicles. A tetraploid 53 × 44 line is being watched with considerable interest, as it often produces three seeds per spikelet as a diploid, and not infrequently four or five. These new lines are to be intercrossed, using as parents those from different geographical regions, as increased fertility may result if some differentiation of the chromosomes has occurred owing to isolation for relatively long periods.

The main advantage of tetraploid sorghum varieties would be that fertile progeny are unlikely to be produced from natural crosses with diploids. New strains issued as tetraploids would therefore not be liable to be lost through natural crossing with the present local types. Tetraploids may also have a wider ecological range, and the larger floral parts may assist in the bird resistance work.

It is always unwise to be too optimistic, and the tetraploid work is too recent to allow of a proper assessment of its value. Nevertheless, the lines growing now look very good, and it is probably true to say that the development of tetraploid types marks a real step forward in sorghum improvement.

(B) *Sorghum Trials.*—The following results were obtained from the old Striga Trial, in which alternate plots are kept clear of Striga, the parasite being left to build up on the remaining plots. Yields are in lb. per acre :

	Without Striga	With Striga	Striga counts on Striga plots
Bukura Mahemba	250	45	14,325
Dobbs	700	725	4,330

It again appears that Dobbs carries less Striga than Bukura Mahemba, and suffers little ill effect from the parasite.

It may be of interest to summarise the results of the Striga rotation trial which have so far been obtained. This trial was put down to see whether various pulling treatments, and rotation with crops which can reasonably be grown on mbuga land, could reduce the amount of Striga.

Treatments are as follows :—

(1) Continuous Bukura Mahemba sorghum, Striga not pulled.
(2) Continuous Dobbs sorghum, Striga not pulled.
(3) Continuous Bukura Mahemba, Striga pulled every 14 days.
(4) Continuous Bukura Mahemba, Striga pulled every 28 days.
(5) Continuous Bukura Mahemba, Striga pulled every 42 days.
(6) Natural Fallow.
(7) 5 years millet.
(8) Rotation, two years millet, one year Bukura Mahemba.
(9) Millet and Bukura Mahemba in alternate years.
(10) 5 years cotton.
(11) Two years cotton, one year Bukura Mahemba.
(12) Cotton and Bukura Mahemba in alternate years.
(13) Two years Dobbs sorghum, one year Bukura Mahemba.
(14) Sunflower and Bukura Mahemba in alternate years.
(15) Gram and Bukura Mahemba in alternate years.
(16) Velvet beans and Bukura Mahemba in alternate years.

All plots were under Bukura Mahemba in the 1949-51 seasons, yields being recorded in the first year, and striga sown and built up in the following two years, treatments commencing in the 1952-53 season. The following is a table of the yields, omitting treatments 6, 7 and 10, which have not yet been under sorghum.

Yields in lb. per acre of grain

Treatment	1949-50	1952-53	1953-54	1954-55	1955-56
1	610	60	20	50	55
2	510	240	75	80	230
3	545	135	50	155	235
4	570	115	30	120	150
5	595	125	30	95	45
8	530	M	M	65	M
9	490	M	25	M	30
11	440	C	C	40	C
12	445	C	25	C	20
13	365	120	120	45	155
14	500	Sf	20	Sf	40
15	555	Gr	45	Gr	40
16	475	VB	20	VB	50

The picture is a dismal one, and underlines the very great damage which Striga can do. The general level of Striga is high, 317,000 Striga plants per acre being the mean figure for one treatment in one season. Clearly rotation is no benefit and Striga pulling is about as effective as growing Dobbs without pulling. It is not clear why the Dobbs yield for treatment 2 in the 1955-56 season is so low, as the other Striga trial gave 725 lb. per acre under what would appear to be identical conditions. All treatments will be planted to sorghum as the indicator crop in the 1957-58 season.

The development of sorghum varieties with a high degree of Striga resistance is clearly most important.

(C) *Rice*.—Further variety trials on selections taken in previous years were done, and the best retained for bulking.

The following are extracts from this season's trials.

Yields are in lb. of paddy per acre

Trial 1. 5 × 5 Balanced Lattice

Selection	Origin	Yield
1/104	Afaa Mwanza	2,615
0/758	Afaa Mwanza	2,525
0/730	Afaa Mwanza	2,500
1/159	Afaa Mwanza	2,455
1/133	Afaa Mwanza	2,425
2/203	Afaa Mwanza	2,400
0/746	Afaa Mwanza	2,375
1/393	Afaa Mwanza	2,370
1/105	Afaa Mwanza	2,340
9/449	Afaa Mwanza	2,330
Afaa Mwanza Control		2,110
Kahogo Control		2,040
L.S.D. at P=0·05		275

Trial 2. 5 × 5 Balanced Lattice

1/166	Afaa Kilombero	3,560
0/906	Afaa Kilombero	3,415
2/208	Afaa Kilombero	3,385
1/196	Afaa Kilombero	3,235
2/217	Afaa Kilombero	3,215
1/177	Afaa Kilombero	3,140
2/214	Afaa Kilombero	3,120
1/194	Afaa Kilombero	3,065
1/167	Afaa Kilombero	2,930
Afaa Kilombero Control		2,790
Kahogo Control		2,605
L.S.D. at P=0·05		320

Trial 3. 5 × 5 Balanced Lattice

1/380	Demerara Creole	2,795
0/295	Demerara Creole	2,595
2/100	Demerara Creole	2,570
0/296	Demerara Creole	2,560
2/91	Demerara Creole	2,525
9/42	Demerara Creole	2,520
2/94	Demerara Creole	2,475
1/404	Shindano	2,410
0/606	Shindano	2,380
1/55	Shindano	2,380
0/602	Shindano	2,860
Demerara Creole Control		2,435
Kahogo Control		2,245
Shindano Control		2,135
L.S.D. at P=0·05		205

Trial 4. 4 × 4 Balanced Lattice

1/355	Introduction	2,995
1/324	Introduction	2,530
Kahogo Control		2,040
L.S.D. at P=0·05		405

Trial 5. 4 × 4 Balanced Lattice

9/426	Kilima	2,370
Kahogo Control		1,975
L.S.D. at P=0·05		355

It has been decided that rice breeding at Mwabagole should be suspended for the present, since rice in the Lake Province is relatively less important than was the case 15 years ago, owing to the great importance assumed by the cotton crop. Rice is largely a cash crop here, and cotton is a superior one.

For the Lake Province, the intention is that the best material should be maintained as small bulks, and tested in the district, where conditions are often markedly inferior to those at Mwabagole. Any that prove markedly superior to Kahogo will be bulked and issued.

The following table shows the selections which have been retained, giving their yields, as percentages of that of Kahogo, for a number of seasons. An assessment of straw strength, shedding, grain shape, and grain flavour, is also included, 1+ being very good, 3 inferior to Kahogo.

Yields of paddy as percentages of Kahogo

Selection	Origin	1956	1955	1954	1953	1951	Straw	Shedding	Grain Shape	Flavour
0/730	Afaa Mwanza	123	130	99	109	—	1	2	2	3
0/758	Afaa Mwanza	124	110	109	100	—	2	2	2	3
0/832	Afaa Mwanza	103	—	104	116	—	1	2	2	1
1/104	Afaa Mwanza	128	113	126	—	—	1	1	2	3
1/105	Afaa Mwanza	115	105	114	107	—	2	2	2	3
1/159	Afaa Mwanza	120	224	131	114	—	1	2	2	3
0/659	Maji Maji	93	—	108	110	—	1	1	3	3
0/906	Afaa Kilombero... ...	131	115	102	133	—	1+	1	2	3
1/166	Afaa Kilombero... ...	137	123	119	—	—	1	1	2	3
1/196	Afaa Kilombero... ...	124	111	122	131	—	1	1	2	3
2/208	Afaa Kilombero... ...	130	220	143	—	—	1	1	3	2
2/214	Afaa Kilombero... ...	120	119	—	—	—	1+	1	2	3
2/217	Afaa Kilombero... ...	123	232	119	—	—	1	1	2	3
9/42	Demerara Creole ...	112	103	89	94	198	3	1+	1	3
0/27	Pishori	82	—	54	60	—	2	1	1	3
0/606	Shindano	106	133	98	102	—	2	1	1	3
1/55	Shindano	106	—	90	99	—	2	2	1	3
1/380	Demerara Creole ...	125	116	89	—	—	2	1	2	3
1/404	Shindano	107	—	70	—	—	2	2	1	3
2/100	Demerara Creole ...	114	120	—	—	—	2	1	1	3
1/324	Introduction	124	111	122	124	—	1+	2	2	3
1/355	Introduction	147	—	107	142	—	1+	2	2	3
1/368	Introduction	108	125	119	89	—	2	2	2	2
2/358	Introduction	105	101	—	—	—	2	2	2	2
9/426	Kilima	120	—	88	87	123	2	1	2	3
9/82	Chimkaga	96	—	91	95	143	1	1	3	3
Kahogo	Controls	100	100	100	100	100	2	2	2	2

The selections in the above Table were chosen to cover a range of material, yield not being the only criterion. Thus, selections from Pishori, Demerara Creole, and Shindano are earlier maturing than Kahogo, and have good grain quality. The original object of the work was to produce rice varieties with similar yield and grain quality to Kahogo, but stronger straw and less tendency to shed. A range of maturity lengths was also required. It can be claimed that good progress has been made.

The Mwabagole rice station and the rice stocks have now been handed over to the Assistant Director of Agriculture, Lake Province.

H. Doggett,
Botanist

MWANHALA RESEARCH STATION

Weather

Year	Month	Rainfall in inches	Years' Average
1955	December	6·29 ...	5·99
1956	January	6·56 ...	5·73
1956	February	4·80 ...	3·89
1956	March	5·11 ...	5·21
1956	April	2·39 ...	5·40
1956	May	Nil ...	1·20

The rains ceased about a month earlier than usual and yields were a little below average.

Maize.

Effect of double superphosphate and sulphate of ammonia on yield.

Yield, lb. per acre

Superphosphate lb. per acre	Sulphate of ammonia lb. per acre			
	0	112	224	Mean
0	817	728	1,176	907
112	1,164	1,769	1,803	1,579
224	1,545	1,691	2,184	1,807
Mean	1,175	1,396	1,721	—

Significant Differences	Body of Table	Means
5 per cent	580 ...	335
1 per cent	760 ...	404

Farmyard manure at rates of 3, 6 and 9 tons per acre was also included in this experiment but had little effect on yields, which were 896, 1,097, 1,019 lb. per acre respectively. Both fertilizers gave large and significant responses but interactions were variable and not significant. In previous work on the station manures usually gave appreciable responses and fertilizers little or no response. Millets and sorghum have been the test crops and they are usually considered unsuitable.

Rice.

Five varieties from the 1955 trial were compared.

Yield in lb. per acre

Variety	1955	1956	Bulk trial 1956
0/659	4,050 ...	1,500 ...	741
1/196	3,340 ...	1,492 ...	800
Kahogo	3,420 ...	1,380 ...	64
1/133	3,560 ...	1,360 ...	—
9/220	3,380 ...	1,340 ...	858
9/42	2,760 ...	1,300 ...	820
P=·05	792 ...	N.S. ...	—

The test varieties yielded as well as Kahogo in the variety trial and better in the bulk trial (approximately ½ acre). They appeared to be more resistant to drought. The varieties 1/196 and 1/133 have received favourable milling reports.

Sorghum and Bulrush Millet.

Thirty varieties of sorghum provided by the Botanist, Ukiriguru, were grown in observation plots. Eight of these yielded from 1,200 to 1,950 lb. per acre. It was noted that varieties with large glumes were hard to thresh.

Several quick growing bulrush millets were grown, they only yielded as well as the local type but matured 6-8 weeks earlier.

Inter-cropping.

Studies comparing yields of pure stands of maize, sorghum and groundnuts with inter-cropping were continued. Statistical analysis has been carried out on a cash value basis.

	Yield, lb. per acre			Cash value Shs.
	Groundnuts	Maize	Sorghum	
Groundnuts	680	—	—	272
Groundnuts and Sorghum	540	—	240	245
Groundnuts, Maize and Sorghum	420	320	30	210
Groundnuts and Maize	280	560	—	181
Maize	—	840	—	101
Sorghum	—	—	375	45

Maize and sorghum 12 cents per lb.
Groundnuts 40 cents per lb.

Significant Difference	5%	52
	1%	71

The sorghum yields were low owing to poor stands. The yield of groundnuts was decreased by inter-cropping with cereals and because of price differences this reduction was not balanced by the value of the cereal crop. The cash comparisons given above do not however correctly represent the effect of inter-cropping from the point of view of the cultivator. If one acre of maize and of groundnuts is planted the cash return in Shs. 373/- but if two acres of mixed crops are planted the return is Shs. 362/-, approximately the same. For groundnuts and sorghum 2 acres of pure crop produce Shs. 317/- but two acres of mixed crop produce Shs. 490/-, a clear gain on cash value for mixed cropping.

Fallow.

The first indicator crop, inter-planted groundnuts and sorghum, was harvested following several types of fallow.

Yields in lb. of groundnut kernels and sorghum grain per acre

	1956		1953-55	
	Groundnuts	Sorghum	Groundnuts	Sorghum
Continuous cultivation, no fertiliser	570	48	385	1,009
Continuous cultivation, single superphosphate 45 lb. in 1953, 65 lb. in 1954 per acre	660	188	545	1,349
Continuous cultivation, shed manure 3 tons per acre 1953	652	204	545	1,359
Cassava fallow	568	324	—	—
Pigeon pea fallow	444	140	—	—
Tumbledown fallow ungrazed	568	316	—	—
Tumbledown fallow grazed	572	296	—	—
Planted grass grazed	528	252	—	—
Significant Difference 5 per cent	112	181	—	—

Heavy losses of crop occurred during the period 1953-55, rosette disease of groundnuts was bad in 1953 and 1955 and Central-shoot fly on sorghum in 1954. The various fallow treatments did not give any improvement in yield in 1956 and taking the four year sequence into account lead to appreciable loss of crop. The applications of 110 lb. of single superphosphate and of three tons of shed manure gave appreciable increases in both crops.

Pasture.

The main grazing areas have been divided into 50-100 acre paddocks and cleared of bush. This has resulted in an appreciable reduction in the area of land required per beast. On the 5-acre experimental paddocks controlled grazing of originally over-grazed eroded land has considerably improved the carrying capacity. Originally about 12 acres were required for one beast, now the paddocks vary from 3·4 to 5 acres per beast and it is thought that further improvement is possible.

Work has begun on the establishment of planted pastures.

J. Bussell,
Agricultural Officer

MARUKU COFFEE STATION

Rainfall 1956	Days	Inches	Average for 5 years Days	Inches
January	13	5·85	12	6·17
February	8	4·34	12	5·24
March	16	5·23	18	7·29
April	26	15·56	21	15·06
May	19	6·91	18	9·87
June	7	4·04	5	1·92
July	5	1·39	6	1·56
August	5	0·84	8	1·44
September	16	2·69	12	3·47
October	11	2·94	15	4·79
November	22	6·39	19	6·99
December	17	4·69	14	5·24
Total	165	60·87	160	69·04

The rainfall was below average throughout the year particularly during the dry season from July to mid-October.

General.

1956 was a year of transition during which many existing trials were concluded and plans were made for new trials to be carried out under the new research programme. The main emphasis will now be placed on research on coffee on land that is already capable of growing coffee and the work on finding methods of rehabilitating the infertile "Rweya" grass land soil will have a lower priority. Plans are being made to extend the coffee research work to sub-stations in the other main ecological regions of the district.

Robusta Coffee.

The trees in the Coffee Selection trial which were planted in 1953 have made good growth after a poor start during their first two years. They now seem to be as good as trees the same age in native shambas on the more fertile "bibanja" soils.

An Establishment Trial was laid down in November testing the effect of compost, lime and artificial fertilisers applied at the time of planting. By digging the fertilisers into the top soil around the seedlings the fertiliser toxicity effects noted in previous years were avoided. Despite a dry spell after planting only 5 per cent died and had to be replaced.

A Coffee Root Study Trial was planted in which the development of the root system under different soil treatments will be studied.

A propagator has been installed for rooting cuttings of robusta coffee. Clonal material will be produced for planting in clone trials and in cultural trials.

Arabica Coffee.

Seed of selections from Lyamungu and Kenya has been planted in nurseries at Maruku and in the district. The seedlings will be planted out in variety trials in four sites in Bukoba and Ngara Districts.

Coffee Pests.

Stephanoderes Berry Borer Control trials have been carried out in collaboration with the Entomologist, Lyamungu. Endrin sprayed on to robusta coffee once a year after the main harvest has been found to reduce the percentage of Stephanoderes damaged cherries to a very low level.

Two White Borer surveys were carried out on arabica coffee in two areas of the district. These showed that the emergence phase of the insect's life cycle takes place only during the short rains period of October-November and not during the long rains in April. Insecticide should therefore be applied just before the short rains.

Bananas.

In the Banana Establishment trial the control plots are making extremely poor growth. Only those plots receiving complete fertiliser are growing well. In some areas the suckers grew well when first planted but have subsequently remained static for the last two years. Micro-nutrients were applied as foliar sprays but no improvement was noticed.

Alternative Cash Crops.

(a) Part of an abandoned tea plantation has been cleared and the trees are making good growth. In the past this tea has survived competition from couch grass and periodic grass fires.

Tea seed was planted in June and the seedlings are now growing well in nurseries.

(b) *Cashew Nuts.*—Cashew seedlings sown in the nursery in June are growing well and appear to be unaffected by the infertility of the soil.

(c) *Wattle.*—A small observation plot of wattle was sown in November. The seed germinated quickly but since then growth has been poor.

(d) *Forestry.*—Podo seedlings were planted in an observation plot in November and are growing fairly well.

Seed of various species of trees has been sown in the nursery for planting out later in observation plots.

Food Crops.

(a) *Bambara Nuts.*—A variety trial was carried out but severe insect damage rendered the results valueless. In an observation trial it was found that Bambara Nuts grown on contour ridges yielded as well as those planted in the native fashion on ridges running up and down the slope.

(b) *Cassava.*—Plots of a number of mosaic resistant varieties were maintained to provide planting material for local farmers.

Soil Fertility Investigations.

In Soil Fertility Trial III marked responses were obtained when pigeon peas were grown in the third year after the fertiliser had been applied. As in the previous two years, when bulrush millet had been grown, the greatest responses were obtained when dung and complete fertilisers were applied.

Micro-nutrient trials were carried out on pasture and millet in collaboration with the Government Chemist and were concluded in May 1956. In general the responses to trace elements were less marked than those obtained from the major nutrients.

Monthly leaf analyses are being carried out by the Government Chemist in which the mineral content of the leaves from poor coffee and bananas on infertile "Rweya" grassland soil is being compared with that of leaves from healthy coffee and bananas growing on the more fertile "Bibanja" land. It is hoped that this will show which nutrients are deficient in the poor soils.

A new trial has been laid down in which the improving effects of deep rooting legumes and grasses on the infertile "rweya" soils will be measured. Elephant grass, Tropical Kudzu and *Dolichos argenteus* are being tested over periods of two, four and six years. The value of an initial dressing of fertiliser will also be tested. The improvement will be measured by growing a test crop of maize in the final year.

Pasture Trials.

Recording of cow grazing-hours was continued on the four quarter-acre paddocks which had received a basal dressing of fertilisers in 1953. In 1956 the grass production was lower than in the previous year because of the dry conditions but the superiority of the treated plots was still marked.

Grazing Trial II. Cow grazing-hours per annum

	Control	Dung	Lime	NPK
September-December 1954	... 183	... 255	... 395	... 263
January-December 1955	... 476	... 920	... 1,135	... 1,105
January-December 1956	... 330	... 455	... 589	... 518

Treatment (applied in 1953)
Dung at 5 tons/acre. N = 1 cwt/acre Sulphate of Ammonia.
Lime at 20 tons/acre. P = 2 cwt/acre Double Superphosphate.
K = ½ cwt/acre Muriate of Potash.

A new pasture trial was laid down to find the effect of lime and artificial fertilisers in increasing the productivity of the natural "Rweya" grassland. This consists of four trials in which N.P.K. Lime are applied at four levels in the presence of basal dressings of those fertilisers not under test.

Livestock.

(a) *Cattle.*—The general health and condition of the cattle has improved considerably during the year as a result of worm drenching, weekly dipping and increased feeding with minerals, concentrates and elephant grass.

A polled Mganda bull has been borrowed from the Veterinary Department and is being used for breeding.

The health and growth rate of the calves have improved enormously during the year as a result of increased feeding with milk, concentrates and minerals. Many cows have very little milk after calving as a result of foot and mouth disease last year and their severe reaction to the K A G rinderpest innoculation. Outside sales of milk have been stopped and those calves whose mothers have insufficient milk are being bottle-fed. Young calves are now being fed with calcium and cod liver oil for their first few days. A few deaths occurred early in the year, mostly due to East Coast Fever, but since June only one calf has died.

H. W. Mitchell,
Agricultural Officer

GENERAL EXPERIMENTAL WORK, LAKE PROVINCE

A. Kisangwa Farm.

The principal development this year has been the establishment of the new Native Authority farm of 26 acres at Kisangwa, Ushashi. The farm is very favourably situated in the centre of the main cotton growing area near to the main road; it incorporates a whole range of soil types from the "Ikurusi" at the top of the hill, through "Matongo" and "Luseni" to "Itogoro-Mbuga" types in the valley. There is no rain gauge in the vicinity but the average rainfall is probably in the region of 35 inches.

The following demonstrations and small trials have been laid down during the year :—

Cassava.—Two different collections of mosaic resistant cassava were planted. The first set of varieties are the mosaic resistant types Amani 405/1, ex Ukerewe, Amani 405/16, Amani 4026/20, Alpine Valence, Msitu Zanzibar and Amani 4026/16. All these varieties are growing well, especially the Msitu Zanzibar, and compare favourably with the local variety. The second collection consists of the new types incorporating Ceara rubber and tree cassavas. They are T 251, C 117, 46106/26, 46106/27, T 206, C 133, TP 186, 4568/3 and 46103/1.

All these varieties will be harvested in 1957.

Groundnuts.—The Tanganyika Agricultural Corporation at Kongwa supplied 4 varieties of groundnuts which were compared with Virginia Bunch and the local variety. The small plot of the variety Asiriya Mwitunde was outstanding and gave a yield equivalent to 1,242 lb. (including shell) per acre. Detailed results are as follows :—

	lb./acre with shell
Asiriya Mwitunde	1,242
Virginia Bunch	773
Spanish 205	635
Local	608
Natal Common	594
Spanish Standard	593

The Asiriya Mwitunde and Virginia Bunch varieties were very resistant to rosette disease but all other varieties were badly affected. The varieties Spanish Standard, Spanish 205 and Natal Common are very palatable but the pods are so small that labour involved in removing them has proved excessive. On the other hand these varieties only took three months from planting to maturity whereas the Asiriya Mwitunde and local types took almost four months.

Citrus.—An orchard was planted consisting of grafted trees obtained from Morogoro. The trees were planted in large box terraces and inter-planted with pigeon peas and both crops have grown well. There are 30 plants altogether consisting of Limes, Oranges, Grapefruit, Lemons and Tangerines.

Finger Millet.—Some varieties of finger millet were obtained from Serere in Uganda for observation to see whether they would be suitable for local conditions. The yields in lb. per acre are as follows :—

Engenyi	1,228
Emeroit	634
Local Musoma	1,038
Ekwangakuit	1,055
Emoru	847
Engon	500

The imported varieties proved to be slightly earlier in maturing than the local types, but the yield has been very variable. There were certain differences in shape of the head of grain and the variety "Emiroit" is of a distinctive red colour being bitter and presumably suitable for "pombe" production.

Maize.—A number of varieties of maize obtained from various places were compared and gave the following yields in lb. per acre :—

Katumbili ex-Nachingwea	2,018
Yellow maize ex-Nakuru	1,320
Yellow maize ex-Kapsabet	1,144
Local Maize—Musoma	1,100
Nakuru local maize	920
Katumbili ex-Tarime	785
Kenya Hybrid ex-Tarime	672
Mixture of Hickory King and Hickory Horse Tooth ex-Nakuru	628

The superiority of the Katumbili maize from Nachingwea is very obvious as also is the poor performance of the local North Mara type. In speed of maturity the local Musoma type and the yellow maizes were the most rapid followed by the ex-Nachingwea type. The later maturing Kenya Hybrid maize and especially the mixture ex-Nakuru gave very well filled grains of good quality. The local types (Musoma and North Mara) did not compare in vegetative growth with the very tall Katumbili ex-Nachingwea. There is obviously a good chance of being able to improve on the local varieties and the better varieties recorded here can be multiplied up in 1957.

Bulrush Millet.—Varieties of bulrush millet have been grown in Musoma for the last three years and the tremendous superiority of the imported varieties has shown frequently. Seed of the best varieties in 1954 was multiplied in bigger plots this year and yields in lb. per acre were as follows :—

Manga	1,105
Zuaranga	907
Local	480

The new types of seed are now available in some quantity and distribution can be made to the local farmers.

Sorghum.—The three varieties which were successful in previous years' trials were multiplied this year and the multiplication plots were cultivated by three different methods, viz. : (a) tractor ploughing and ridging, (b) ox ploughing and

ox ridging and (c) hand tie-ridging. The tractor cultivation done by contractors was left far too late and a poor job was done as is reflected in the yields given below in lb. per acre :—

Variety	Tractor Cultivation	Ox Cultivation	Hand Cultivation
Suk I	341	1,214	1,149
Enyanza	1,128	1,948	2,078
Kano	1,374	1,572	2,268
Local Musoma type ...	1,071	1,542	1,560

The main reason for the poor performance of Suk I on the badly cultivated area was an attack by covered smut—the extent of the attack was approximately proportional to the type of cultivation as is shown below by the percentage count of smut infested heads carried out by the Botanist, Ukiriguru :—

Variety	Tractor Cultivation %	Ox Cultivation %	Hand Cultivation %
Suk I	39	17	33
Enyanza ...	28	19	1
Local	1	—	—

The above plots were all planted on 6th March, 1956 and were ready for harvesting as follows :—

Suk I—mid-June
Enyanza—early July
Kano—end July
Local—end July.

In addition to these multiplication plots, a large number of new varieties obtained from the Botanist, Ukiriguru, have been tried out.

Fodder Crops and Grasses.—A number of fodder legumes and drought resistant grasses were planted at Kisangwa, with varying success. Seeds from these varieties have not yet been harvested. Panicum Millet, even though it was planted late (21st April, 1956), grew very rapidly and was harvested on 7th July, 1956, giving a yield equivalent to over 1,000 lb. per acre.

Coffee.—A small demonstration plot of Arabica coffee was planted and is growing well.

Small holdings.—A part of the Kisangwa farm is devoted to an experimental small holding. A demonstration of the poultry deep litter system and ark-folding system is attached to the small holding.

The following trials on cotton were laid down at Kisangwa :—

(a) *Fertilisers.*—Four plots, not replicated, were planted on 1st December, 1955.

Control	Superphosphate 100 lb./acre ...	Superphosphate 200 lb./acre ...	Superphosphate and Sulphate of Ammonia each 200 lb./acre.
1,053 lb./acre ...	1,514 lb./acre ...	1,596 lb./acre ...	1,650 lb./acre.

(b) *A Model Plot.*—A cotton plot treated with dressing of 13 tons per acre FYM : 200 lb. per acre Superphosphate, 200 lb. per acre Sulphate of Ammonia and plants dusted with B.H.C., yielded 1,769 lb. of seed cotton per acre.

(c) *Time of planting trial (Cotton).*

Date of Planting	Yield—lb. per acre
22.11.55	1,105
8.12.55	1,280
22.12.55	971
8.1.56	1,177
22.1.56	1,349

(d) *FYM Trial.*—A non-replicated trial with an application of 14 tons per acre of FYM :—

Control—1,448 lb. seed cotton per acre.
FYM—2,329 lb. seed cotton per acre.

(e) *Variety Trial—Cotton.*

Variety	Yield per acre—lb.
MZ 561	1,554
UK 51	1,648
Mwanza Local	1,699
UK 48	1,253
0/334	1,698
1/686	1,602
UK 55	1,743

B. Tarime and Kinesi Farms.

These two farms have suffered once again from the usual labour troubles, lack of adequate supervision, and untimely planting. At the Kinesi farm (9 acres), cotton planted in January and February was again heavily attacked by bollworms and stainers and produced a negligible yield.

At the Tarime farm (42 acres) the cultivation experiment is still being harvested. Inadequate labour resulted in lack of uniformity in treatments. The crops harvested to date on the different plots are as follows :—

Yields in lb. per acre

	Trash Bunds	Grass Strips	Elephant Grass Bunds	Tie-ridging	Flat Cultivation
Groundnuts	246 ...	124 ...	289 ...	107 ...	208
Eleusine	230 ...	136 ...	239 ...	71 ...	89

Maize—harvesting not yet complete.

C. Eradication of Prickly Pear.

A campaign was launched in North Mara in 1955 against the increasing infestation of pasture land by prickly pear *(Opuntia spp.)*. The communal turnouts became very unpopular as the work is both difficult and painful and many of the most ruthlessly treated clumps have grown even more vigorously this year.

Experiments on chemical control were transferred from North Mara to Musoma this year and some encouraging results have been observed. The materials being used are :— "Phortox" (active principle 2,4,5-T), "Tricate" (Sodium T.C.A.), Karmex (80 per cent CMU) (active principle 3-1-1-D) and Atlacide (a white powder containing sodium chlorate).

(i) "Phortox". This material has been sprayed on to the foliage at various concentrations and for a varying number of times. The response is very rapid and where heavy doses are applied the cladodes or leaves turn yellow and then brown and eventually drop off together with flower heads.

It is expected however that the stems and fruits, will not be seriously affected and will sprout again.

(ii) "Tricate". This material has been received in quantity only very recently and it has been sprayed (in mixture with water in varying concentrations) on to the plants. Again, with the heavier doses, fall of "leaves" and fruits is rapid and happens within a week of application. Earlier plants sprayed lost all their "leaves" but started to shoot again from the main stem.

(iii) "Karmex". Mixed with water, has been applied by watering-can as it is expected to attack the roots of the prickly pear. Results are not yet apparent. As this material is believed to cost Shs. 70/- per lb. it is unlikely to be a practicable control measure.

(iv) "Atlacide". Has also been applied by watering-can in various concentrations to the roots of the prickly pear and has so far resulted in slight yellowing of the plants and heavy fall of fruits. Further responses are awaited.

It is intended to follow up some of the more drastic weed killers by fire and very recently the scale insect *Dactylopius tomentosus* has been received from South Africa for further trials. In addition, a species of Euphorbia which appears to be able to cover and stifle prickly pear plants is also under trial.

II.—Sukumaland

A. Lubaga Farm.

The area under field crops and experimentation has been reduced considerably. Rotation experiments have been discontinued. Crop yields at the farm were low due mainly to Bollworm attacks on the cotton and sorghum. Results of the experiments are included with the Ukiriguru report.

B. Maswa.

The E.A.A.F.R.O. type fertiliser experiment at Nunghu showed that in the second year boma manure gave the best residual response. Results for the nitrogen and phosphate were not significant.

1955/57 Results—Crop, Bulrush Millet

	C	N	P	NP	FYM
lb. per acre	759	769	943	803	1,311
lb. above control ...	0	10	184	43	551

S.E. = 2·8 Significant difference at 0·05 = 298
Significant difference at 0·01 = 364

Kwimba.

Trials were laid down on African shambas in several places to find the first year residual effect of superphosphate.

Crop	No. of Plots	P + N	Nil	Sig. diff.
Cotton... ...	7	463	318	74
Cotton... ...	9	474	312	77
Cotton... ...	9	366	266	78
Bulrush Millet	7	252	126	76
Bulrush Millet	7	532	341	188

Response to phosphate and nitrogen were generally significant and in the case of cotton of economic value.

Rice Variety Trial.

Twenty-five varieties of rice were planted at Malya in one-thirtieth acre plots with no replications. Most of the varieties were Afaa selections. Some of the yields were very high, but Kahogo came into head much earlier than the Afaa and yielded equally well :—

Variety	Yields in lb./acre of the six best varieties
D 759 (Afaa)	6,630
1/159 (Afaa)	6,780
1/104 (Afaa)	5,970
1/158 (Afaa)	5,730
0/446 (Kahogo)	6,000
2/214 (Afaa)	5,550

Cotton.

Time of planting trials carried out in the Nassa area of Mwanza District again proved the benefit of early planting.

Date of Planting	Yield per acre
24th November, 1955	... 880 lb.
15th December, 1955	... 553 lb.
5th January, 1956...	... 520 lb.
26th January, 1956...	... 336 lb.

Bukoba.

Cotton.—A time of planting trial was laid down in October at Kyaka. An eighth of an acre was planted each month with UK. 51. The figures were not impressive with the highest yields being just over 600 lb. of seed cotton per acre : half of this amount was fifi from the October plantings. The percentage of Grade "A" improved monthly and this was inversely proportional to the incidence of stainers. The plants appeared to carry a heavy potential crop and the low yield obtained is to some extent due to wide spaced ridging giving a small plant population :—

Date of Planting	Grade A lb.	Grade B lb.	Grade A %	Yield per Acre lb.
17th October, 1955	14 ...	62 ...	17·9 ...	608
3rd November, 1955	19 ...	42 ...	31·1 ...	488
10th December, 1955	17 ...	21 ...	44·7 ...	304
6th January, 1956	26 ...	15 ...	63·4 ...	328

M. Lunan,
Assistant Director

GENERAL EXPERIMENTAL WORK, WESTERN PROVINCE

Stem-borer of Maize.

The incidence of stem-borer varied considerably from district to district and results are only quoted from areas where the incidence was reasonably high. In Nzega eleven trials of two and a half per cent DDT (in ground coral) increased yields from an average of 490 to 860 lb. per acre. This is equivalent to an increase of Shs. 33/- per acre for an expenditure of Shs. 7/50. These plots were manured and probably better cared for than ordinary maize fields. In Tabora the increase was lower, about 200 lb. per acre.

Local cultivators are actively interested and some are prepared to buy insecticide for their own use next season.

Wheat.

Twenty-four varieties of wheat were tested at twelve sites varying in altitude from 6,000 to 7,000 feet. Some sites proved unsuitable on account of soil type and on others natural hazards, hares or cattle destroyed promising stands.

Of the early varieties Kenya Governor did quite well and excited local interests because of its earliness compared with local varieties. A yield equivalent to 2,265 lb. per acre was obtained on one plot. At Msanzi four samples of local wheat ranged from 1,200 lb. to 1,800 lb. per acre, the varieties under test varied from nil to 1,200 lb. per acre.

Rust incidence was generally low.

C. Glegg,
Provincial Agricultural Officer

REGIONAL RESEARCH CENTRE, ILONGA

GENERAL REPORT

Weather.

The season on the whole was a good one, the rainfall being sufficient, and what is more important, well distributed. For all practical purposes the rain ceased at the end of April, but there was sufficient moisture left in the soil to enable those crops which were planted at the end of February to carry through until they were harvested, without any very large decline in yield. Table 1 shows the total rainfall for the growing season and its distribution in two gauges. The office gauge is situated at the foot of the slopes of the Ukaguru Mountains and the field gauge one and three quarter miles almost due south of the office gauge on the plain stretching away from these mountains. It will be seen that there was quite an appreciable difference in the amount of rain registered at each gauge. For all the agronomic experiments with the exception of the maize variety trial, and all the soil fertility experiments the field rain gauge readings should be applied.

TABLE 1

Month	Field Gauge		Office Gauge		
	Amount of rain	Number of days on which rain fell	Amount of rain	Number of days on which rain fell	Average for 10 years
1955:	ins.		ins.		ins.
December ...	5·59	15	6·70	17	5·18
1956:					
January ...	5·63	18	6·54	19	5·70
February ...	3·73	12	5·74	11	4·20
March	5·41	11	7·44	13	6·88
April	12·91	22	17·11	22	8·06
May	0·91	12	0·23	12	3·18
June	0·71	4	0·98	6	0·25
	34·17	94	44·74	100	33·45

GENERAL ACCOUNT OF THE WORK FOR THE SEASON

Groundnut Experiments.

Effect of double superphosphate, placed, on yield, var. Natal Common, planted 22nd February and harvested 99 days after planting.

TABLE 2—FERTILIZER TRIAL

Treatments	Wt. of Kernels Recovered lb./acre	Wt. of Kernels Gleaned lb./acre	Population Thousands acre	Shelling Percentage
No phosphate	629	86	24·9	56·8
50 lb./acre	624	60	25·5	54·9
75 lb./acre double Super-phosphate	635	62	24·9	60·3
Sign. Diff. P=·05	112	23	2·1	3·6
P=·01	155	32	2·9	5·0

There were no significant differences between the weight of kernels recovered but the gleanings on the unfertilised plots were significantly higher (at the five per cent level) than those on the fertilised plots. The populations were very uniform. Due to the late planting the yields were low but as will be seen, Table 3, they compare favourably with the yields of the same variety planted within a week of the same date.

TABLE 3—TIME OF PLANTING TRIAL

Planted at approximately 14-day intervals starting on 16th January, 1956, var. Natal Common, planted mechanically on ridges, no fertiliser.

Date of Planting	Wt. of kernels recovered lb./acre	Wt. of kernels gleaned lb./acre	Population Thousands/acre	Shelling Percentage
16th Jan. Harvested after 105 days ...	1,311	7	28·4	55·3
31st Jan. Harvested after 101 days ...	902	28	30·0	56·5
14th Feb. Harvested after 101 days ...	669	30	24·4	61·3
28th Feb. Harvested after 98 days ...	591	72	28·3	63·5
15th Mar. Harvested after 99 days ...	253	11	29·6	65·8
P=·05	152	20	2·4	4·3
P=·01	207	27	3·3	5·8
S.E.	±52	±7	±0·8	±1·5

The first two plantings gave a significant increase over all the others even though the shelling percentage of the first planting was significantly lower than the last three. Indeed as far as yields are concerned in all cases except one (the fourth) the yields of each planting are significantly lower than its predecessor, thus indicating that early planting is essential for this crop and showing that even a fortnight's delay can seriously reduce yields. The reduction in growth period observed at later planting dates is similar to that observed in other parts of the territory.

The populations were low and somewhat variable. In no case were the gleanings excessive.

Cercospora leaf-spot disease attacked the first two planting only slightly, the third and fourth badly and the fifth very severely, practically defoliating it. For the last three plantings the soil was hard at the time of digging.

TABLE 4—TIME OF DIGGING TRIAL

Five times of digging at seven days intervals starting 86 days after planting, planted mechanically on ridges on 8th March with no fertiliser, var. Natal Common.

Treatments	Wt. of kernels recovered lb./acre	Wt. of kernels gleaned lb./acre	Population Thousands/acre	Shelling percentage
86 days after planting	814	60	26·7	63·9
93 days after planting	919	137	26·2	69·6
100 days after planting	1,199	112	27·1	70·4
107 days after planting	1,065	112	25·9	72·5
114 days after planting	897	143	25·2	68·3
Sign. Diff. P=·05	109	52	3·9	3·9
Sign. Diff. P=·01	153	74	5·5	5·4

It would appear that this variety should be harvested between 100 and 107 days after planting when the yields are highest but the gleanings are not significantly higher than those of the second digging. Populations were fairly even and there were no significant differences between them.

Between 93 and 107 days the shelling percentage becomes significantly greater than in the first digging.

After 86 and 93 days Cercospora attack was slight but for the last three diggings it increased rapidly in severity. The ground was hard at the time of harvesting for all diggings.

TABLE 5—TIME OF DIGGING TRIAL (VARIETY MWITUNDE)

Five times of digging at seven-day intervals starting 107 days after planting, planted mechanically on ridges on 13th February, no fertiliser, var. Asiriya Mwitunde.

Treatments	Wt. of kernels recovered lb./acre	Wt. of kernels gleaned lb./acre	Population thousands/acre	Shelling Percentage
Dug 107 days after planting	637	86	29·0	66·6
Dug 114 days after planting	609	169	27·0	71·7
Dug 121 days after planting	832	170	28·0	72·1
Dug 128 days after planting	542	152	28·8	69·1
Dug 135 days after planting	325	184	27·9	66·3
Sign. Diff. P=·05	226	62	3·2	4·1
P=·01	316	87	4·5	5·8

Total yields on the whole are low because the experiment was planted late but even so the period between 114 and 121 days after planting would appear to be the best time to harvest this variety. The populations are uniform. Shelling percentages at both 114 and 121 days are significantly better than for 107 and 139 days, at five per cent level. Cercospora attacks followed the usual pattern, were slight on the first two diggings but increased in intensity on the last three. The ground was hard at the time of harvesting for all diggings.

Maize Experiments.

TABLE 6—TIME OF PLANTING TRIAL

Each of the five dates of planting was a separate experiment consisting of three methods of planting. The methods used were: planted on tied ridges; planted on ridges; planted on the flat. The variety was Katumbili (ex Ilonga), no fertiliser was used, and each experiment was planted mechanically and thinned to a standard spacing (9 plants per six feet run of row) after germination.

Treatments	16th Jan. (102 days)	31st Jan. (101 days)	14th Feb. (102 days)	28th Feb. (100 days)	15th March (103 days)
	Dates of Planting (Yields in Lb./Acre)				
Planted on the flat	815	1,832	2,697	1,900	1,226
Planted on ridges	840	2,022	2,725	1,897	1,410
Planted on tied ridges	803	2,062	2,570	2,015	1,296
Sign. Diff. P=·05	168	201	307	429	267
P=·01	239	286	437	610	380

The figures in brackets under the various dates represent the number of days from planting to harvesting. Within experiments only one significant increase at the five per cent level was recorded (on the experiment planted on 31st January) in favour of planting on tied ridges. This is unusual and is probably due to the excellent and well distributed rainfall. Populations were very even and only in the experiment mentioned above was there a significant increase.

The rainfall and its distribution were very good for all dates of planting except the last. The yield at the first date of planting was exceptionally low. However there was heavy rain throughout the ten-day period of pollination of

this particular planting, probably resulting in poor fertilization. Also the grain from this particular experiment when harvested was small and contained many shrivelled-up silks which seems to indicate a poor set of seed.

Table 7 shows the mean yields between the various times of planting.

TABLE 7

Date of Planting	Yields lb./acre
16th January	819
31st January	1,972
14th February	2,664
28th February	1,937
15th March...	1,311

There were very considerable differences in yield resulting from the different dates of planting.

TABLE 8—FERTILIZER TRIAL

The effect of 75 lb. of double superphosphate placed at the time of planting, 100 lb. sulphate of ammonia top dressed 34 days after planting, and a combination of the two. Planted by machine on 22nd February and harvested 107 days later; var. Katumbili.

Treatments	Yields lb./acre	Population Thousands/acre
No fertiliser	2,151 ...	16·7
Phosphate	2,039 ...	16·2
Nitrogen	2,120 ...	16·0
Phosphate and nitrogen ...	2,014 ...	16·0
Sign. Diff. P=·05	197 ...	1·0
P=·01	272 ...	1·3

As with the groundnut fertiliser experiment there were no significant differences between treatments or populations.

TABLE 9—MAIZE POPULATION EXPERIMENT

Spacings at 6 inches, 9 inches, 12 inches, 15 inches, 18 inches and 24 inches apart in 42-inch rows. Planted on tied ridges on 28th February and harvested after 112 days. Variety Katumbili. No fertiliser.

Treatments	Yields lb./acre	Populations Thousands/acre
6″ spacing	1,512 ...	24·90
9″ spacing	1,582 ...	16·60
12″ spacing	1,504 ...	12·45
15″ spacing	1,504 ...	10·37
18″ spacing	1,331 ...	8·30
24″ spacing	1,106 ...	6·22
Sign. Diff. P=·05	208 ...	—
P=·01	283 ...	—

There was very little difference in yields between spacings of 6 inches to 15 inches and even the 18-inch spacing was not significantly lower at the five per cent level. This is somewhat unusual compared to previous experiments on maize spacing, and is probably due to the excellent growing conditions experienced this year. It would appear that if the stand of maize is between ten and twenty thousand plants per acre there is no need for the grower to increase his production costs by laborious hand thinning.

TABLE 10—MAIZE VARIETY TRIAL

Planted on 9th February 12 inches apart in 42-inch rows. Harvested between 14th May and 20th June according to variety. No fertiliser used. Design: Randomised blocks (4 replications).

Variety	Yield lb./acre	Variety	Yield lb./acre
Katumbili	2,646	Njoro flat white	1,790
Nyanza...	2,594	Buganda local	1,704
Kitale flat white	2,542	Rongai Yellow	1,712
Katumbili (Nachingwea)	2,412	Muratha (Namulonge)	1,086
Hickory King	1,946	Muratha (Nairobi)	1,556
Ulu	1,920	K.8	1,219
Katumbili (Ilonga)	1,868		

Maize Breeding.

Maize breeding work has been confined to the improvement of the local white Katumbili by the Brieger method.

Katumbili is very variable in many characters and many plants exhibit undesirable characters. In this method an attempt has been made to remove as many of these undesirable characters as possible such as extruding cob tips, clusters of cobs, coloured grain, weak straw and lack of vigour. The basis of selection has been high yield, flint type grains with well shaped cobs and an average of 14 vertical rows of grain per cob.

The original selections (940) were made by the Agricultural Officer in charge in 1953 and grown to produce S1 in 1954. This seed was sown by the Botanist in 1955 and considerable discarding on the characters already mentioned carried out to reduce the lines to about 200. S2 seed from these lines was sown under irrigation in 1955. Growing conditions were not entirely satisfactory but sufficiently good for the production of S3 seed. Both S2 and S3 seed were grown during 1956 and, from observations on these, sixteen lines selected to form the components of the synthetic. Sixteen pounds of a mixture of S3 and S4 seed was obtained from these selected lines. Eight pounds of this seed has been sown under irrigation this year for recombination. The seed from this will be regrown in isolation next year. The other eight pounds of seed will be recombined in isolation next year. A comparison can be made in 1958 on once grown synthetic, twice grown synthetic, Nachingwea synthetic parent Katumbili and any other variety of interest.

Soya Bean Experiments.

TABLE 11—FERTILISER TRIAL

The effect of 75 lb. double superphosphate per acre, 100 lb. sulphate of ammonia per acre and a combination of the two fertilisers. The phosphate was placed at the time of planting and the sulphate of ammonia applied as a top dressing 46 days after planting. Planted mechanically on 5th March and harvested on 3rd July.

Treatments	Yield lb./acre	Population Thousands/acre
No fertiliser	609	... 87·8
Phosphate	545	... 84·6
Nitrogen	592	... 87·5
Phosphate and Nitrogen	596	... 79·4
Sign. Diff. P=·05	105	... 11·8
Sign. Diff. P=·01	145	... 16·4
S.E.	±35	... ±3·9

The differences in yields or populations were not significant. The yields are in general low as a variety unsuited to this area was used. In observation plots two other varieties of soya bean grew far more vigorously and yielded better. These varieties will be used for future soya bean experiments.

TABLE 12—TIME OF PLANTING TRIALS

Treatments	Yield lb./acre	Population Thousands/acre
Planted 14th February (harvested after 117 days) ...	879	62·7
Planted 5th March (harvested after 115 days)... ...	761	83·7
Planted 15th March (harvested after 124 days) ...	624	59·3
Planted 5th April (harvested after 124 days)	452	94·4
Sign. Diff. P=·05	161	15·5
Sign. Diff. P=·01	223	21·4
S.E.	±53	±5 1

There was a progressive reduction in yield with later dates of planting. The first planting was significantly higher at the one per cent level than the third and fourth plantings. The variations in population were largely due to different soil conditions at the various times of planting. As with the soya bean fertiliser experiment yields were low. No inoculum was used and in all treatments nodulation was far from good.

Sorghum Experiments.

A fertiliser trial was laid down on sorghum using the variety Early Shallu. The design was the same as the fertiliser trial on maize. Unfortunately heavy and uneven damage by birds occurred and the variation in plot yields was very great. Nevertheless the same general picture emerged as with all the other fertiliser experiments and there were no significant increases due to the applications of phosphate or nitrogen or both.

In a storage test on sorghum where weevils were deliberately introduced into small samples of grain, Early Shallu kept better and longer (6½ months) and suffered far less damage than any other white variety tested.

Miscellaneous Crops.

Records were taken of 46 varieties of castor, 164 varieties of sorghum and numerous other crops (mainly leguminous) which were grown on the station in observation plots.

F. M. Spencer,
Agricultural Officer

REGIONAL RESEARCH CENTRE, ILONGA

COTTON BREEDING

General.

Throughout the province the season began with early heavy rains making preparation of gardens difficult and resulting in late planting. In some areas, flooding or the rate of growth of natural vegetation was so great that food crops were not planted, and cotton was still being planted in late May. In the drier areas of the Province (i.e. Bagamoyo) there was early planting rain in February and no more until April; the rains stopped in early May.

Insect attack varied in the different areas, being very heavy in the Mwaya area and Kilosa District and relatively light in Kissaki and Bagamoyo. Pink bollworm, American bollworm and Spiny bollworm were the main pests. Jassid was not serious—though it was on Ilonga, probably due to late planting generally.

The best methods of cotton cultivation in the Eastern Province are reasonably clear cut now. Final confirmation should be obtained with district plot trials in the various districts next year.

Recommendations are February planting with a Jassid resistant variety, treated weekly with 10 lb. DDT/BHC dust, or equivalent spray during the insect attack in April, May or June; spacing at one foot between plants, one plant per hole, rows 3 feet apart.

It should be emphasized that only early planting with the use of insecticide will give increased yields. Early planting without dusting or late planting with dusting will not give better crops.

Table 1 shows the results obtained over a number of years for sowing distances and times of planting.

TABLE IA

Time of planting. Comparative yields per cent Dusted cotton

	Ilonga			Kissaki
Year	1954	1955	1956	1956
Date of planting:				
8th February	—	100	100	—
15th February ...	—	—	—	100
22nd February... ...	100	—	—	—
1st March	—	—	—	—
8th March	—	39	—	—
15th March	60	—	54	91
4th April	2	2	—	63

TABLE IB

Distance of sowing—Comparative yields per cent Dusted cotton.

Ilonga

Year		1954	1955		1956	
Distance between plants in 3 ft. rows	Plants per hole	March Planted	February Planted	March Planted	February Planted	March Planted
6″	1	99	89	—	84	100
12″	1	100	100	100	85	77
18″	1	89	91	—	—	—
24″	2	—	84	82	90	66
36″	2	70	87	61	100	47

No increase in production can be expected until widespread use of insecticide is practised. This season the Department of Agriculture ran demonstration trials which have helped considerably to convince growers. Numbers of growers are buying dust to use next year, especially in areas where bush schools were conducted in conjunction with demonstrations.

The results of spacing between plants and time of planting trials this year at Ilonga and Kissaki (south-east of the Uluguru mountains) are shown in Table 2.

TABLE 2

Spacing and Time of Planting Trials

Ilonga. Dusted with 10 lb. weekly applications of cotton dust for 9 weeks;

Kissaki. Dusted weekly for 8 weeks with 10 lb. cotton dust.

Yields lb./acre seed cotton

		Ilonga		Kissaki	
	February planted	dusted	not dusted	dusted	not dusted
1.	6″ between plants 1 plant per hole	936		—	—
2.	12″ between plants 1 plant per hole	938	no	1,983	868
3.	24″ between plants 2 plants per hole	992	cotton	—	—
4.	36″ between plants 2 plants per hole	1,107	to	1,711	765
5.	36″ between plants 3 plants per hole	927	pick	—	—
	No significant differences				
	March planted				
6.	6″ between plants 1 plant per hole	655		—	—
7.	12″ between plants 1 plant per hole	506	no	1,801	881
8.	24″ between plants 2 plants per hole	434	cotton	—	—
9.	36″ between plants 2 plants per hole	307	to	1,581	985
10.	36″ between plants 3 plants per hole	408	pick	—	—
	Sign. Diff. P=·05	192		—	—
	April planted				
	12″ between plants 1 plant per hole	—	—	1,244	687
	36″ between plants 2 plants per hole	—	—	1,102	609
	Sign. Diff. P=·05 all treatments	227	—	363	238

Kissaki—dusted cotton

Distance between plants	Yields in lb./acre seed cotton (Mean yield for three dates of planting)
12″ between plants 1 plant per hole	1,676
36″ between plants 2 plants per hole	1,465
Sign. Diff. P=·05	220
Date of sowing	**Mean yield at 2 different sowing distances**
February planted	1,847
March planted	1,691
April planted	1,173
Sign. Diff. P=·05	180

Ilonga

Rainfall was adequate and distributed well.

The cotton plots were planted next to a large acreage of maize mainly to see if control was effective with routine 10 per cent DDT/3 per cent BHC dusting under conditions of extremely heavy bollworm attack.

Trials, including dusted and not dusted treatments, gave the following yields. If dust had not been used, no cotton would have been picked.

TABLE 3

Comparison Between Dusted and Not Dusted Treatments—Ilonga 1956

Trial	Mean yield in lb./acre seed cotton		Flared squares (damaged buds) per acre on 19th May, 1956	
	dusted	not dusted	dusted	not dusted
Sowing distance and time of planting:				
February planted	980	Nil	30,000	56,000
March planted	462	Nil	9,000	38,000
Interplanted trial:				
February planted	1,571	6	18,000	60,000
Cultivation trial:				
February planted	1,071	12	13,000	47,000
March planted	1,024	Nil	10,000	34,000
Total acreage	6 acres	4 acres	Average plant population 15,000 per acre.	

Jassid was present in large numbers and enabled the breeder to select resistant types easily. Most of the answers to cotton growing in Eastern Province have been confirmed with this season's work. More time can now be spent on plant breeding.

Sowing distance, time of planting and comparison of dusted and not dusted plots will be tested at centres in the province next year to give accurate confirmation of the Ilonga conclusions for the province generally.

COTTON CULTIVATION TRIALS

Three trials were conducted. The results of sowing distances; time of planting trial are shown in Table 2.

In an interplanting trial, cotton gave much poorer yields when interplanted with maize. Cotton was also interplanted with a short strawed sorghum. The sorghum was very poor and the yield of grain was very low, 390 lb./acre. This reduced the competition effects and the cotton yield was as high as that in the pure stand of cotton. Interplanted beans were completely smothered by cotton. The cotton yields equalled that of the pure stand cotton.

Two replications of this trial were not dusted. No cotton was picked from these. Maize yields were slightly lower than in the dusted plots.

Cultivation trials, planted in February and March, gave the results shown in Table 4. The object of the trials was to compare the economic return from cotton cultivated at various levels of husbandry with dust and without dust

TABLE 4

Levels of Cultivation, Ilonga

Planted 1. 10th February, 1956.
2. 8th March, 1956.

Treatments:

1. Clean throughout, thinned early.
2. Weeded and thinned 14 days treatment 1. Then clean weeded throughout the rest of the season.
3. Weeded and thinned 28 days after treatment 1. Then clean weeded throughout the rest of the season.
4. Weeded and thinned once 10 weeks after planting.

Treatment 1 was cleaned and thinned 21 days after planting in February Trial.
Treatment 1 was cleaned and thinned 12 days after planting in March Trial.

Yields Lb./Acre Seed Cotton

	February planted			March planted		
	dusted	not dusted	total weedings	dusted	not dusted	total weedings
1.	1,023	25	5	1,126	Nil	5
2.	1,120	9	4	1,054	Nil	4
3.	1,002	5	3	943	Nil	3
4.	491	6	1	660	Nil	1
	211	N.S.	—	185	—	—
Sign. Diff. (P=·05)						

Cost of dusting one acre in terms of seed cotton is 140 lb. seed cotton per acre. On the dusted plots the value of clean weeding is considerable.

All dusted plots showed a profit. No not-dusted plots showed a profit.

This trial was planted at the base of the foothills and it is presumed that ample moisture was available from rainfall and seepage to enable the cotton to grow equally well in all treatments, except the badly neglected variant. A factor affecting the results was that February planted cotton grew more vigorously but dusting started a little late. Consequently, bolls were lost and growth was rank, resulting in a similar yield to the smaller, timely-dusted, March planting, where the full potential yield was picked.

PLANT BREEDING

With the picture of cotton cultivation now reasonably clear, the type of plant required can be more easily assessed in regard to field characters. Jassid resistance, and a short plant of compact habit with high yields is needed. This, from results of yield trials and measurements of daughter strains, has enabled the range, type and number of selections and parent bulks to be cut considerably for next year.

In the coming season, it is hoped to plant progeny rows to define more accurately the value of lint indices, combed lint length and ginning outturn as selection characters, also, whether a plant with a large number of small bolls is better than a plant with fewer larger bolls in relation to dusting in insect attack. All assessments will be made on February planted dusted cotton on Ilonga, on the assumption that this is to be the usual method of cultivation in the province.

Next year, 47/10 will be distributed in the remaining areas of Eastern Province. 47/10 lacks jassid resistance, there is urgency therefore in producing a new strain so that the risk of heavy jassid damage in early planted cotton is minimised. With cotton dust being used more widely, and with the present recommendation for February planting, the need is pressing. Of the strains tested at district plots this year, several are fairly good for most characters. Therefore as an interim measure, a mixture of several of these strains (i.e. a multi-line issue) will be grown and tested at Ilonga and district plots next year. If suitable, initial bulking can then start.

VARIETY TRIALS

Main Variety Trial.

This trial of 9 strains in a 3 × 3 balanced lattice, was planted at Ilonga, Mwanya, Kissaki and Msoga. Yield figures are shown in Table 5.

TABLE 5

ILONGA AND DISTRICT VARIETY TRIALS—YIELDS

Yield in lb./lint per acre

	Ilonga		Mwaya	Kissaki	Msoga
	dusted	not dusted	dusted	dusted	dusted
Date planted	22.2.56	22.2.56	20.3.56	2.4.56	3.4.56
Strains:					
51/61	609	78	534	345	145
51/111	664	91	515	410	136
51/110	708	77	518	375	153
53/122	652	81	570	366	194
53/128	720	87	471	422	162
53/192	734	91	549	346	142
53/193	737	62	471	396	172
53/125	699	78	485	358	167
Local	510	45	421	347	151
Sign. Diff. P=·05 ...	127	25	107	N.S.	37

All strains have some expression of hairiness on the leaves but none has the amount required for resistance against heavy jassid attack.

Ginning percentages were as good as "Local" (30·4 per cent) at all sites for all strains; there were no significant differences between combed lint lengths. However, due to drought, Msoga provided the hardest conditions and lint samples from this plot have been sent for spinning tests.

Seed coat damage counts were below 20 per cent for all strains. Blackarm was negligible.

53/122, 53/128 and 53/125, all daughter strains of 51/77, have been given good spinning reports in tests, and further selection has been carried out in this group for improved jassid resistance.

1954 Selection Trials.

Two 7 × 7 balanced lattices were planted on 23rd February to test the remaining 1954 selections. Both trials were badly attacked by pests and full potential yields were not realised although control with dusts was adequate. One trial tested 42 selections against the original parent types and "Local". Details of the characters compared are shown in Table 6, for some of the

selections. Yields were significantly higher than "Local" and the lint for most strains was longer than "Local". All the later selections had better jassid resistance than parent types or controls. Ginning percentages were low. A few selections gave lower ginning outturn than "Local" but none lower than 47/10. The low ginning percentages were probably due to the season and the site (rich alluvium soil). In the previous season, all the selections had ginning percentages over 30 per cent.

In the other trial, the remaining forty-eight 1954 selections, were tested against "Local". The average yield was 632 lb./acre, part of the crop being taken by American and Spiny bollworms. The general trend was similar to that shown in Table 6. Yield differences were greater, three strains producing twice as much cotton as "Local", partly due to a shorter habit allowing better control with insecticide. Ginning percentages were even lower than those given in the Table—the ginning percentage of "Local" being 26·8 per cent—fourteen of the selections had lower ginning outturns than this.

From a total of ninety strains tested, fifty-three will be tested again next year. The number of original parent types is now twenty. Half of the remaining 1954 selections are derived from 4 original parent bulks 51/111, 57/77, 48/69 and "Local".

SUMMARY OF CHARACTERS FOR A NUMBER OF SELECTIONS MADE IN 1954

Comparison with Original Parent and "Local"

Trial A	Lint yields as percentage of "Local"	Ginning outturn percentage	Weight of 100 seeds in grammes	Mean lint length in m.m.'s	Lint Index	Jassid
45/4 ...	163	28·4	9·8	35·9	3·8	3
54/51	187	27·7	9·6	37·4	3·7	2
54/52...	171	29·1	10·3	36·8	4·2	2
54/55...	177	27·9	10·7	38·9	4·2	2
48/69...	168	26·7	10·5	36·2	3·8	3
54/142	168	27·6	10·5	37·5	4·0	2
145	197	27·1	10·8	34·7	4·0	1
148	173	29·0	10·0	36·3	4·1	2
155	228	29·1	10·6	37·1	4·3	2
48/67...	195	28·1	9·9	35·5	3·9	3
54/220	193	27·3	10·0	35·6	3·8	2
221	186	27·2	10·8	34·5	4·0	1
223	189	27·2	10·8	37·2	4·0	1
44/11...	156	28·1	11·0	35·2	4·3	3
54/234	199	31·7	10·0	36·3	4·6	
Local	100	27·8	9·9	34·4	3·8	3
47/10...	—	25·4	9·5	35·1	3·2	4
Sign. Diff. P=·05	31					
Average yield	915 lb./acre					
C. of V.	9%					

Jassid grading 1 resistant; 5 susceptible.

'51 and '53 Strain trial (4 × 4 balanced lattice). This trial, planted on 13th February, was badly attacked by Pink, American and Spiny Bollworms and yields were poor; differences were not significant. Rank growth and poor grade cotton made observations and measurement of seed characters difficult. Four strains have been kept as parents on the performance of progenies selected in previous years.

'56 strains. 216 new selections were made this season.

Irrigation types.

One hundred and sixty-seven strains were grown in small plots and rigorous selection was done to reduce the numbers. From information obtained over the past two seasons 32 strains have been kept for planting at Lumemo in the Kilombero Valley next year at the Tanganyika Agricultural Corporation pilot irrigation plot.

Strains were discarded on Jassid susceptibility, low ginning outturn and short lint lengths.

Of the imported types, the Sudan strains were attenuate in habits, slow in fruiting, opened poorly and were jassid susceptible. Three however will be planted under irrigation next year. Of the Uganda types several had poorer lint than that required, others suffered from Jassid; one has been kept for irrigation tests. Of the Ukiriguru strains two have been kept but it is doubtful if the lint will be comparable to that of the local selections.

Next year, when material has been grown under irrigation and spinning reports have been obtained, the picture should be clearer.

APPENDIX

Summary of Strains

Eastern Province Local 47/10	The original commercial cotton in the Province, mainly of Uganda "Local" origin. A selection from "Local" due to replace "Local" completely in the Province in the coming season.
44/ to 48/ strains	All selections made previous to 1951 from Eastern Province "Local".
51 strains	Strains selected in 1951 from pre 1951 strains.
53 strains	Strains selected in 1953 from pre 51 strains, 51 strains and Eastern Province "Local".
55 and 56 strains	Strains selected in 1955 and 1956 from pre 51 strains, 51 strains, 53 strains and Eastern Province "Local".
Irrigation types	Strains selected for good lint characters for possible irrigation schemes from Eastern Province "Local", Lake Province, Uganda and Sudan.

R. Smith,
Plant-breeder (E.C.G.C.)

REGIONAL RESEARCH CENTRE, ILONGA

ENTOMOLOGY

American Bollworm (Heliothis armigera).

A small number of larvæ were found on pigeon pea, okra, and tomato during September, and then none at all in October. However the weather from mid December seems to have been particularly favourable for the rapid build-up of American bollworm. In late November, moths which presumably came from emergence after the first shower of rain, began to lay on irrigated maize. Laying continued till the middle of December. From then on it rained almost continuously till March, so that there was a constant supply of food plants—volunteer maize, early planted maize and groundnuts—on which this infestation could develop before the cotton became attractive. There was a slight decrease early in February but an increase again later in the month.

The first egg laying in cotton took place in the second week of February, on cotton planted on 16th January and adjacent to volunteer maize. In the main crop, i.e., February planted, eggs and larvæ were found in the third week of March. Egg laying continued until the beginning of June at which time the larva population in unprotected cotton reached a maximum (approximately 20,500 per acre). Then the number declined rapidly so that very few larvæ were found in cotton in July. In this month the infestation transferred first to chickpea and then to pigeon pea. As the chickpea crop was sparse the population was relatively low, but in the pigeon pea—an area 40 acres—the numbers were much higher than in any other crop. Collections made in early August, which were mainly of 6th instar larvæ, showed that at least 76 per cent were parasitised by a Tachinid.

From this time till the end of September a few specimens were found in pigeon pea and chickpea which had not yet dried; also on riverside maize.

Spiny Bollworm (Earias supp.).

This pest was first recorded in cotton in March, and remained at a relatively low level until the end of May. It increased gradually in June despite insecticide treatment and even though there was a slight decrease after the treatment period there was another rise in numbers reaching a maximum just before picking started. There was little difference in the level of infestation in different treatments, except in the higher application of spray.

Pink Bollworm (Platyedra gossypiella).

Larvæ of this pest were found in cotton throughout the whole season, from first flowering to the opening of the last bolls, and was the heaviest attack experienced for many years. Late and incomplete uprooting and "standover" crops were certainly responsible for this situation. Some volunteer and standover plants in the vicinity of the station, examined in January/February, were heavily infested.

The earliest laying on the station took place during February in cotton planted on 16th January. Counts taken in opening flowers from the beginning of March, and during the maximum flowering period, showed that at least one quarter of the buds were infested. Pink bollworm were also present in February planted cotton throughout the season, from the formation of the first buds, but not at such a high level as in the earlier crop.

Stainers (Dysdercus spp.).

D. intermedius was present in low and variable numbers particularly during April and May. Staining was only observed in late fruiting plots.

Aphids.

In treated cotton, aphids were never of importance, and the infestation increased only in unprotected cotton late in the season. The colonies developing during the rains were largely controlled by a fungus disease.

Jassid.

As in the previous season, jassid seriously reduced the yield of unprotected cotton. All insecticide treatments adequately controlled the infestation.

Insecticide Trial.

This was a trial using various formulations as sprays, and the "standard" dust application, to test efficiency in the control of the main cotton pests and using equipment which might be adapted to African farming conditions.

Spacing: Single plants at 1 ft. spacing in 42 in. rows.

Strain: 47/10

Equipment: Four "Oaks Ross" Knapsack sprayers; standard model.
Swaine dust blower.

Insecticide applied weekly for 8 weeks.

Treatments.
A. ¼ lb. DDT per acre per application, spray
B. ¼ lb. DDT + ¼ lb. BHC per application, spray
C. 1 lb. DDT + ¼ lb. BHC per application, spray
D. 1 lb. DDT + 0·3 lb. BHC per application, dust
} in 6 gallons water per acre
E. Control.

The cotton was planted on 13th February, weeded on 5th March, thinned on 7th March, and subsequently weeded by hand. Insecticide applications were started on 25th April, when the flared square (damaged buds) count exceeded one per plant.

Jassid was present in the crop soon after planting, and increased in numbers until the start of insecticide applications when they were adequately controlled in all treatments. American bollworm eggs were first recorded in mid-March, i.e. one month after planting and before flowering. A few Spiny bollworm larvæ were also found at the same time but did not increase until May.

When spraying treatments were started the cotton already had reached over four feet in height, and continued to grow rapidly until at the end of the season plants were between six and seven feet high. This tremendous growth led to increasing difficulties in spraying operations and was probably responsible for less efficient distribution of insecticide.

TABLE 1

Summary of Insect Pest Records.—All pest and damage counts as numbers per 100 plants per week, during the period of insecticide application : yields in pounds of seed cotton per acre.

Treatment DDT	BHC	Flared squares	American bollworms	Spiny bollworms	Pink bollworms	Yield lb./acre seed cotton
A. ¼ lb.	...	131	29·3	19·4	9·9	573
B. ¼ lb.	¼ lb. ...	141	36·1	16·8	5·6	650
C. 1 lb.	¼ lb. ...	68	16·3	8·0	4·7	1,536
D. 1 lb.	0·3 lb....	168	44·5	17·8	6·5	742
E. Control	...	338	87·4	30·5	9·9	166
Sign. Diff. P=·05		23·5	9·2	20·8	1·14	64

Observation on Pest Records.

1. There was no significant difference between A and B (¼ lb. DDT and ¼ lb. DDT + ¼ lb. BHC) in flared squares, American and Spiny bollworms, but there was a difference in the Pink bollworm population at one per cent level. The inclusion of BHC reduced the population to almost half that in the plots treated with DDT only. Counts of Pink bollworms were made in opening flowers only, so that the actual populations would be greater than those shown in the table, especially in the controls in which most of the buds were damaged (by American bollworm) before flowering.

2. Treatment C : 1 lb. DDT + ¼ lb. BHC per acre per application as a spray gave better control of all insect pests than any of the other treatments and very much better than the equivalent application of dust.

3. Treatment D : 1 lb. DDT + 0·3 lb. BHC per acre per application as a dust gave adequate control, and although the pest counts indicate a less effective control, especially of American bollworm, than the lower rates of spray, the final yield was considerably higher.

Discussion.

The strain used, 47/10, is a very vigorous type, and this year when grown on good land reached a tremendous height. Some plants were over 7 feet high at harvesting time, and many were lying on the ground. The size and height of plants led to difficulties in spraying operations.

The yields show that under these conditions spray is more efficient than the equivalent application of insecticide as a dust. The differences in yield between the spraying treatments were greater than was expected. This was probably due to the overwhelming infestation of insects, from adjacent maize and large areas of unprotected cotton, not being adequately controlled by low rates of application to large plants. It is felt that the differences would have been proportionately smaller in shorter cotton, but this aspect will have to be investigated more thoroughly.

Economics of Treatments.

The following costings are based on the actual costs of the insecticides used in the experiment. Insecticides from other sources are in some cases very much cheaper.

TABLE 2

Value of crop based on 57 cents per lb. for grade "A" seed cotton, and 20 cents for grade "B". Costs and values in shillings per acre.

Treatment	Seed cotton lb. per acre	Grade A %	Value of crop	Cost per acre	Seed cotton per acre equivalent to cost	Profit per acre over control
A.	573	69·3	261/59	25/20	44	162/49
B.	650	75·7	312/03	159/20	279	78/938
C.	1,536	85·2	791/18	234/80	412	482/48
D.	742	83·3	377/06	80/00	140	223/16
E.	166	66·8	73/90	—	—	—

It will be seen from the table that although treatment C was the most expensive it resulted in the biggest profit, which seems to indicate that the higher the application—up to that level—the greater the profit. The yield from treatment B was significantly higher than that from treatment A, but its cost was considerably greater, so that the actual profit was much less.

The amount of BHC in both treatments B and C might well have been reduced, to bring down the cost without seriously reducing efficiency. This point will be investigated next season.

Dusting with 1 lb. DDT + 0·3 lb. BHC per acre per application is the present recommendation for African growers.

Timing of Crop Protection.

Spacing : Single plants at 1 foot intervals, in 42-inch rows.

Planted : 13th February, 1956.

Variety : 47/10.

Treatment : 1 lb. DDT + 0·3 lb. BHC per application as a dust.

Equipment : Swaine dust blower.

TABLE 3

Effect of delay in protection against insect pests.

Treatment	Period of protection	Yield in lb. seed cotton/acre
A	April 27th—June 22nd	1,185
B	May 25th—July 20th	583
C	None	174

This small trial was laid out mainly to demonstrate the effect of a delay in the protection of cotton from insect pests. It is known that the cotton plant is capable of compensating fully for a loss of buds for periods up three months. Under the prevailing local conditions however if protection is delayed the plant suffers not only from loss of buds, but also from leaf and physiological damage by a number of insects particularly Jassid, so that when protection is afforded the plant is not able to compensate to the same extent. The results of this trial strengthen the case for early protection.

Development of cotton in relation to American bollworm attack.

An examination of the records of American bollworm in cotton at Ilonga over the past 12 years shows that up till 1949 the attack began in the second or third week of May, reaching a peak in the second or third week of June then

decreasing till the end of July. In the following five years the attack gradually became earlier, starting at the beginning of May or end of April. The peak varied from the first to the third weeks of June, the population curve tailing off again to the end of July. In the past two years, with generally earlier planting, i.e. in mid-February rather than late March, the beginning of the infestation was slightly earlier still and the peak advanced to the beginning of June. There has also been a gradual increase in the level of infestation from 1944.

In order to find some relation between development of the crop and expected time of infestation by American bollworm, records were taken of the development of cotton planted at fortnightly intervals from mid-December until late March. Weekly counts were made of the numbers of buds, flowers, bolls, and open bolls. Rainfall from December 13th until the middle of March was almost continuous, so that it was possible to plant at regular two weekly intervals.

The following table summarises the information obtained.

TABLE 4

Summary of development records. Figures of buds and bolls are totals per plant. Plot size 5 rows of 10 plants at 1 ft. intervals.

Plot	Planting date	Start of flowering	Period in flower weeks	Start of Opening	Period of harvest weeks	Total buds formed	No. Bolls harvested	Approx. yield/acre	Percentage saleable cotton
1	17.12.55	11.2.56	20	14/4	21	96	30	2,380	71·5
2	30.12.55	28/2	19	28/4	18	90	26	2,030	82·5
3	14.1.56	10/3	15	5/5	15	112	37	2,580	85·0
4	28.1.56	17/3	14	12/5	15	83	27	2,100	93·5
5	11.2.56	3/4	13	9/6	12	73	27	2,320	94·5
6	25.2.56	16/4	11	16/6	11	47	18	1,900	96·5
7	10.3.56	5/5	10	7/7	9	20	10	1,070	98·0
8	24.3.56	28/5	7	28/7	6	16	6	510	100·0

The records can conveniently be divided into two groups, one from the first four plantings, and the other from the later four plantings.

Group one :

(a) There were two flowering peaks with a complete break of two weeks (in April) in the first planting.

(b) Bolls began to open before the expected cessation of rain by 6, 5, 4 and 3 weeks in successive plantings.

(c) Rapid shedding of small bolls took place in early April after a dry spell in March.

(d) First flowers were infested by Pink bollworm.

(e) The last flowers were formed in each plot within two weeks of each other.

Group two :

(a) Only one flowering peak, the period of flowering becoming more concentrated with each successive planting.

(b) Difference in times of last flowers only two weeks.
(c) No bolls opened during rain.
(d) Percentage of saleable cotton greater than in group one.
(e) Losses by shedding tended to be less than in group one.

The flowering curve which most nearly approximates the pattern of infestation by American bollworm (as recorded in the field in cotton planted in mid-February this year) is that of plot 6, planted on 25th February. That is the increase in the number of small bolls took place at the same time as the bollworm infestation was building up, whereas in earlier planting boll formation was slightly in advance of the bollworm build up.

There are many factors involved in the determination of an optimum planting period, but it seems to be necessary to plant early enough to allow the plant to form some crop before the expected time of infestation by American bollworm, but to avoid possible infestation by Pink bollworm and damage by rain, bacteria and fungi to opening bolls.

However, if there is any advantage in planting early to minimise damage to the first bolls, the entry of American bollworm cannot be avoided, so that the crop must still be protected when infestation does take place.

African "Cotton Club" Plots.

Three African farmers cultivating cotton on the boundary of the Research Station were given technical assistance in the control of insect pests. The fields, of 1 acre, 2 acres and $2\frac{1}{4}$ acres in extent, although rather late planted, were well cultivated throughout the season. Insecticide was applied with a standard "Oaks Ross" knapsack sprayer, at the rate of $\frac{1}{4}$ lb. DDT per acre for 4 weeks and $\frac{1}{4}$ lb. DDT + $\frac{1}{4}$ lb. BHC for the second 4 week period. This was regarded as the minimum rate which could be recommended, but unfortunately it was not enough to control the heavy attack, particularly of Pink bollworm, and the yields were disappointingly low.

The cost of insecticide (Shs. 40/- per acre) was equivalent in value to about 80 lb. of grade one seed cotton, so that there was little "profit" from the yield of 300 to 420 lb. seed cotton per acre. However the cultivators themselves are satisfied with the results as it is much better than what they are used to. They intend to increase the size of their plots and at least double the application of insecticide in the 1957 season.

SUMMARY OF PRACTICAL METHODS OF INSECTICIDE APPLICATION

Dust : 10 per cent DDT plus 3 per cent BHC applied once weekly at 10 lb. per acre. Applied by Swaine dusters or Rotary dusters at the onset of insect attack.

Sprays : DDT (emulsion) at the rate of 1 lb. DDT (in 6 gallons of water) per acre per application, plus $\frac{1}{4}$ lb. BHC if required for control of Aphid, using knapsack sprayers. Lower rates than the 1 lb. DDT still give adequate control but effectiveness decreases below that rate.

E. Valentine,
Entomologist (E.C.G.C.)

COAST RESEARCH STATION, BAGAMOYO

Weather.

The year 1956 proved to be an extremely dry one—in fact the driest since the Government took over the station. 31·77 inches of rain were recorded compared with the Bagamoyo average of 40 inches and the Chambezi average of 48 inches.

In January, above average rainfall was experienced but although both temperatures and humidity were high during February and March there were long periods of dry weather, and insufficient rain fell for planting paddy or coconuts until the main rains broke in early April. Good rains were experienced during April and May and a succession of light showers during the first half of June, but from that time hardly any rain fell until after Christmas. Under 3 inches of rain fell during the last six months of 1956 and the whole station was looking extremely brown and dried up by the year's end.

Rainfall figures for the year were as follows :—

Month	Inches	Days	Bagamoyo average
January	5·52	12	3·47
February	1·07	1	2·61
March	2·57	7	4·07
April	11·35	20	9·14
May	6·22	12	7·51
June	2·21	12	1·53
July	·11	1	1·27
August	·09	3	1·16
September	·14	3	1·02
October	·68	4	1·28
November	·30	4	3·16
December	1·51	7	4·12
Total	31·77	86	40·34

Experimental Work.

(a) *Coconuts.*—It was decided early in the year to discontinue the method of establishment trial owing to the large number of palms which had died due to water-logging in this area.

The hole size and fertilizer trial and the 3 × 3 fertilizer trial were continued, treatments being repeated where appropriate. Palms in these two trials are growing extremely well though there have been a few losses due to rhinoceros beetle.

Several new trials were started during 1956 to try and determine both the cause and possible cures for "tapering disease" of palms.

From leaf samples sent to the Government Chemist for analysis it seemed likely that it might be due to trace element deficiencies and palms suffering from disease were injected with certain trace elements (S, Fe, B and Mo). Injections were done in January but recoveries have not been noted.

It has been suggested that tapering disease may be caused by a root fungus. Roots from palms suffering from tapering disease were placed against roots of several healthy palms to test this possibility. So far there is no sign of having infected the healthy palms with the "disease".

From Ceylon it is claimed that palms suffering from tapering have successfully grown away from its effects when additional earth has been heaped some 4 feet high round the base of the palms—the palms putting out new roots into the soil. Six palms suffering from tapering at Chambezi were surrounded with extra soil in July to test the validity of this claim, but it will be some time before any results will be forthcoming.

Coconut growers throughout the Territory annually experience losses both in nuts and revenue from copra through the damage caused by *Pseudotheraptus wayi*. Although spraying is a possible answer, particularly on large estates, the expense and difficulty of application will prove a limiting factor for the smaller growers. Two other possible methods of limiting damage are therefore under investigation at Chambezi.

A study of bearing palms showed that where Maji Moto ants *(Oecophylla longinoda)* were plentiful on the palms the nuts were free of damage. On the other hand where Nyenyele ants *(Pheidole megacephala)* were present there were no Maji Moto ants and the coconuts showed damage. Trials have begun to breed up Maji Moto ants in the neighbourhood of palms by providing suitable nesting bushes and at the same time to eradicate Nyenyele ants by means of dieldrin.

The second method is a long term one. There is some evidence that certain crosses of palms (tall x dwarf) produce a palm bearing nuts having some resistance to *Pseudotheraptus* damage. Pollination experiments were begun at Chambezi towards the end of the year to pursue this line of investigation.

A further coconut experiment which has recently been laid down at the station is one designed to determine whether applications of N.P. and K will give economic responses when applied to bearing coconut palms. Palms which have been yield recorded for 4 years are being used. The first applications of fertilizer was carried out on 30th October, 1956.

(b) *Cassava*.—Twenty-five varieties of cassava which were selected for their mosaic resistance in trials at Mlingano, near Tanga, were planted in experimental plots at Chambezi in the short rains of 1955 to see whether they maintained their resistance on the coastal sands. Plants were debudded twice to make conditions as severe as possible. Individual plant by plant recording for mosaic was carried out in April, 1956 before de-budding, and again in June, when some recoveries were noted. Of the 25 varieties 8 were considered to be reasonably resistant, and these, together with a local variety called Kibangiri which also appears to be resistant to mosaic, were laid down in a further trial on 30th November, 1956. The varieties were—

5315/39, 5315/40, 5317/21, 5318/5, 5318/34, 5342/1, 50676/9, and 53121/22.

All 25 varieties were harvested in December when weight, palatability and brown streak were recorded.

(c) *Pineapples.*—The pineapples in the experiment laid down in the short rains of 1954, to test the effects of fertilizers and mulch, both in the "open" and under the shade of coconut palms, came into bearing during 1956. A few fruits were harvested as early as April, May but the majority from November onwards. All fruits are being weighed individually—final figures will not be available for some time as harvesting of fruits continues. Tests carried out on some of the fruits showed them to be unsuitable for canning purposes.

(d) *Rice.*—Observational plots were laid down to note the most promising of 25 rice selections for the Botanist, Ukiriguru. In addition to these selections a further two from Ukiriguru, two from Zanzibar and eight grown the previous year at Chambezi were also tried.

Straw strength, shedding, and yield were recorded at harvest time. Yields of the 8 ex-Chambezi were very disappointing, but this must be put down to poor germination due to bad storage conditions prior to sowing. Afaa and Kahogo proved the best, as in previous years here. The yield of the two selections from Zanzibar were not up to expectation but produced very good samples. Of the Ukiriguru selections three were outstanding in producing over 3,000 lb./acre. Unfortunately these suffered from shedding out, however. The selections were 1/104, 1/166 and 1/194.

(e) *Annual Crops.*—The distribution of rainfall at this station, heavy for two months of the year and low for the remainder, poses problems as to the best dates for planting various crops in conjunction with manuring, fertilizing, mulching and ridging practices. Observational trials have therefore been started to test dates of planting, comparing FYM, grass mulch and bare soil at each planting date for various annual crops. No results are to hand since these trials have only recently begun.

(f) *Cashew.*—As a result of the Entomologist's investigations on the station in 1955 into the control of *Helopeltis spp.*, on cashew, it was decided to dust both Portuguese East and Zanzibar cashew trees using a powered duster during 1956. Three dustings were carried out at 15 day intervals during June and July using a Mistral 1 knapsack type power driven dusting machine and ·5 per cent gamma BHC dust applied at the rate of 30 lb. per acre per application. Both varieties of cashew were three years old. Dusting cost Shs. 8/- per acre per application. Harvesting of the nuts has just been completed. Yields were Zanzibar 380 lb. per acre and Portuguese East Africa 510 lb. per acre. Both varieties were found to have roughly the same weight of kernel to shell but the Zanzibar cashew contained 32·9 per cent shell oil compared with the 29·7 per cent of the Portuguese East Africa cashew.

J. V. Webdale,
Agricultural Officer

MBOZI COFFEE RESEARCH STATION

Rainfall.

The following is a summary of the monthly rainfall and distribution :—

Month	Rainfall in inches	Distribution in days
January	13·67	28
February	7·39	21
March	6·01	20
April	14·00	25
May	2·89	7
June	0·19	2
July	Nil	—
August	Nil	—
September	Nil	—
October	0·77	3
November	3·19	8
December	8·54	14

The distribution is good. The very heavy fall in April is worthy of note.

Several hail showers were recorded but little damage was done. There was no repeat of last year's frost in August.

Coffee.

Early in the year the trees in four Latin Squares of Experiment 1 were uprooted. The trees concerned were so much out of step that the trial was valueless. Approximately 2½ acres of the old Experiment 1 remain and will be uprooted when the new trial bears its crops. This small section of old coffee is carrying a fair crop and is a useful training ground, particularly for pruning.

Experiment 1.

The new variety trial will take the form of a randomized block replicated nine times. Twelve selections will be tested probably AB11, AB35, H66, L1, N5, N39, N105, N197, KP154, KP423, P313 and R23. If so desired plots can be split to test single and multiple stem.

Experiment 2.

Treatments.—Ammonium sulphate at 4 oz. per tree was applied to appropriate plots in March and again in November. Mulching was completed by mid-April. A zinc-boron mixture was again sprayed on to alternate rows of plots.

The experiment has made satisfactory progress and the first crop was recorded. As a matter of interest the totals of cherry from each treatment are given as follows :—

	Yields of cherry, lb. per acre.	
	Nil	Sulphate of Ammonia
Control	566	977
20 lb. Hyparrhenia (in row)	545	522
40 lb. Hyparrhenia (complete cover)	462	321
20 lb. Banana trash (in row)	620	470
40 lb. Banana trash (complete cover)	551	680

The yields are very small when reduced to terms of clean coffee but by Mbozi standards the results are encouraging and rather more than one-seventh of the trees have yet to bear.

There was an excellent flowering in November and the setting was very good, the results from the coming season's picking will be more helpful.

There is very little visual difference between the sprayed and unsprayed rows. Very little black tip was seen anywhere in the experiment, the unsprayed possibly showing a little more than in the sprayed rows. One tree only showed die-back and that only in a row which had been sprayed.

The Chroton shade trees have made excellent growth and would seem to be satisfactory for Mbozi conditions, the trees only lose their leaves for a period of about six weeks.

The plots which receive ammonium sulphate showed no sign of strain in the dry season. Trees in the untreated plots developed a yellowish colour at the start of the rains but those which had been treated looked healthy and made new leaf at an astonishing pace.

Experiment 3.

Treatments.—Pruning treatments were applied in January. It is now considered that this is the wrong time and it is recommended that in future pruning is done in late October—early November.

Half of the trial was treated with a zinc-boron spray and the other half with a zinc spray and a boron ground application.

All trees received an application of 4 oz. of sulphate of ammonia in April and again in November.

For some reason this trial looked rather yellow towards the end of the rains but there was a marked improvement during the season probably owing to a build up of nitrogen and since then progress has been excellent. Six trees suffered from die-back, not severe, but have since recovered, the same trees showed die-back symptoms last year. This experiment was recorded for the first time and the yields were good. The results however mean little as the treatments have not yet had time to affect the cropping. The treatments are beginning to show up quite distinctly.

Experiment 4.

The planting of this fertilizer experiment was completed in January. The layout (96 plots of 16 trees) in a 2^4 factorial replicated 6 times. The four fertilizers are ammonium sulphate, double superphosphate, sulphate of potash and agricultural lime at 134 lb., 134 lb., 100 lb. and 100 lb. respectively to the acre.

Plots are sub-divided into 4 sub-plots of four trees each. Major treatments were applied in January and again in November. Sub-plots were sprayed in late November—early December the four treatments being (a) Control, (b) Zinc-Boron, (c) Zn + B + Mg, (d) Zn + B + Mg + Mn.

This experiment is making satisfactory progress.

Nursery.

Seed of 24 selections was planted in January and early February. Germination was good of the earlier planted selections but the others germinated patchily and on investigation it was found that some of the seed

had rotted, this was almost certainly due to an unusually high rainfall in April when the nursery was under water. One selection, N198, was almost a complete failure there being only a 2 per cent germination. There were two beds, both equally bad, and as the selections in close proximity germinated well the fault, almost certainly lay with the seed.

Pests and Diseases.

Green Scale.—Only two trees were affected, the routine Dieldrex application for White Borer has the additional advantage of checking the ants attendant on the scale.

White Stem Borer.—Dieldrex at 1 per cent was applied early in November and appears to have been very successful. One larva only was found and that in the old coffee in Experiment 1. It is essential that methylene blue be used as a dye-stuff when applying Dieldrex as some careless work would otherwise go unnoticed.

Cut Worm.—Dieldrex applied early in May at $\frac{1}{2}$ per cent to all young plants (i.e. up to 2 years from seed) almost solved this problem. A few plants were however still damaged in the period June to August and have since been removed.

Thrips.—There was a heavy thrip infestation in September and all trees were sprayed with Arkotene at 0·1 per cent. Only one spraying was necessary.

Giant Cricket (Gymnogryllus minrus Saus).—This pest made an unwelcome reappearance after an absence of 5 years. Some twenty plants were damaged. The crickets responsible were traced to their burrows and dug out. Four insects were caught.

Cercospora.—Young plants were affected in the irrigation plot and in patches elsewhere resulting in heavy leaf fall. Copper, in the form of Perenox, was sprayed on and the disease, at first checked, soon disappeared.

"Dieback" and "Black Tip".—Apart from the spraying carried out on the station several new off-station trials were laid down. The yields from last year's sprayed plots were recorded. The results of the latter have been forwarded to the Government Chemist. It is interesting to note that on the twice sprayed plot on red soil the crop was trebled. The results of the plots on the volcanic soil were very disappointing. The farmer concerned reported that this year's flowering in the plots was blackening off and when an inspection was made it was found that the damage was not confined to the sprayed plots. A number of trees were uprooted and the root systems exposed were bad. The planting holes had been filled with an astonishing amount of sub-soil and there was evidence of an almost complete lack of consolidation. The plots on this farm have been abandoned.

General Observations on Coffee.

The first essential in Mbozi is properly planted coffee. It is rather early to say but it would seem that irrigation will increase yields considerably. Over a five year period it has been noticed that the flower spike is put out late in August. Flower spikes unprotected by leaf are scorched beyond recovery by the time the rains arrive. Often there is an early isolated shower which brings

the undamaged spike into flower and with no rain following up the flower fails to set. That irrigation will remedy this state of affairs to some extent is not pure surmise, one farmer has irrigated a plot of old coffee over a two year period and the results have been surprisingly good. There is not the slightest doubt however that irrigation in a marginal area such as Mbozi must be treated with caution.

Wheat.

A fertiliser trial and green manure trial were laid down at the end of February. The green manure treatments were laid down in December and ploughed in at the end of January. Both trials were a complete failure, plant height varying by as much as 18 ins. within a plot. The land was previously planted to coffee which was pulled out in 1954, and was deep cultivated to eradicate Lalang.

The off-station trials were disappointing. A variety X nitrogen trial and a fertiliser trial were laid down. On the former it was found that there was a significant difference between N and no N at the 1 per cent point of probability. A significant difference at 5 per cent was 102 lb. per acre (i.e. between the two means). A variety X time of planting trial on the same farm prospered but there were no significant differences between yields of varieties or planting dates.

Miscellaneous Crops.

Plots of Dwarf Hungarian Castor, Bitter Lupin (S.E. Blue) and Cowpea (Dr. Sanders Upright) were harvested and the seed retained for further planting. Three bags of Lupin (Bitter Blue) were obtained from Kenya and planted late in February. It was not possible to inoculate the seed and the results were poor, some eight bags were harvested. Three bags were sold to local farmers for green manuring. A small quantity of each of four varieties of velvet bean was obtained from Mpwapwa so late that little more than double the original amount of seed was harvested.

Grass.

A one acre plot of Rhodes Grass yielded 2 bags of seed with which a further 1½ acres were planted up. This grass is very promising both for hay and pasture purposes.

Orchard.

In the upper orchard the citrus trees are very promising and now that irrigation is possible crops should be increased considerably. The peach trees progress slowly, none bearing more than a small crop but most of the fruit set, unlike last year. The apple trees have done very well even very young trees are bearing a crop. The plum trees make no progress and have yet to bear, this despite the fact some of the trees are six years old.

In the lower orchard the Queensland Nut trees are at last bearing a small crop. The Pecan Nut trees have made very little growth but they continue to look healthy.

D. P. Allan,
Agricultural Officer

GENERAL EXPERIMENTAL WORK, EASTERN PROVINCE

Mlali Irrigation Scheme

Weather:

Rainfall (Morogoro 2nd order station)

		Inches	Days	Average for 36 years, Inches
1955	December	3·48	12	2·81
1956	January	4·70	17	3·78
	February	8·15	9	3·79
	March	2·91	8	6·93
	April	12·20	26	8·15
	May	3·13	10	3·87
		34·57	82	29·33

Rainfall distribution during the growing period was exceptionally good, consequently there was little need for irrigation during the season.

Rice.

In a time of planting trial, using the variety Kahogo, December plantings yielded significantly better than January plantings. Later plantings were virtually failures.

Date	2/12/55	21/1/56	24/2/56	11/3/56
Yield per acre	4,600	2,008	408	120

In a variety trial, spacing 16 × 16 ins., transplanted Afaa significantly outyielded the other three varieties and Karafuu was better than Kikweta or Kahogo.

Yield, lb. per acre			
Afaa	Karafuu	Kikweta	Kahogo
2,207	1,378	1,176	1,132

Twenty-five selections provided by the Botanist, Ukiriguru, were grown in observation plots. Eleven of them were rejected as being unsuitable on account of yield and tendency to shattering of grain.

Off-season Cropping.

Twelve types of European vegetables were grown in observation plots to select suitable varieties for retail on the Dar es Salaam market.

D. Chambers,
Agricultural Officer

GENERAL EXPERIMENTAL WORK, SOUTHERN HIGHLANDS PROVINCE

Njombe District

Weather.

Throughout the district rainfall was well above average but the following dry season was unusually arid. Frosts occurred in July and August in the higher area but were not severe enough to damage crops.

		Rainfall, inches Wangingombe	Uwemba
1955	November	—	1·3
	December	11·1	9·9
1956	January	11·3	15·9
	February	10·4	15·1
	March	4·4	14·9
	April	4·6	15·7
	May	—	1·9
	June	—	0·2
	July	—	0·1
	August	—	0·2
	September	—	—
	October	—	—
	Total	34·9	74·0

Wheat.

Three varietal trials incorporating manure or superphosphate were successfully carried out.

TABLE 1

AT LUPEMBE

Variety	No Manure	lb./acre 5 Tons of Manure	Mean
354	398	777	588
Sabanero	410	640	525
Kenya Settler	367	584	476
$337BB_2F_2$	301	403	352
184P	305	364	335
$358P_3D$	287	354	321
1,066	140	344	242
Kenya Governor	14	42	28
Mean	278	439	—
Significant Differences	P = 0·1 per cent for varietal means		132 lb.
	P = 1·0 per cent for manure		66 lb.

Although germination and early growth were promising the season was unusually wet and no variety matured properly. Glume blotch was very prevalent but stem rust did not appear. Rats caused severe losses at harvest time to some varieties, particularly to 354 and 358. Kenya Settler and 1066 however seemed unattractive to them. Both 354 and Sabanero yielded appreciably and significantly better than 337 and varieties yielding less. Manure gave useful responses.

TABLE 2

AT UWEMBA

lb./acre

Varieties	Nil	150 lb. double-superphosphate	Mean
Regent	2,108	1,195	1,632
Sabanero...	1,374	1,503	1,439
Equater	1,354	1,327	1,341
$341F_2D_2$	953	1,507	1,230
1,066	1,009	1,390	1,200
Hopeful	860	992	926
261 R	151	355	253
Kenya Governor	168	135	152
Mean	997	1,051	—

Significant Difference. P = 0·1 per cent, varietal means 294 lb.

Phosphate had no significant effect on yield. The soil was a good forest soil. Germination and growth was good throughout. Five of the varieties are particularly promising.

TABLE 3

AT MTWANGO

lb./acre

Variety	No Manure	5 Tons of Manure	Mean
354	831	1,933	1,383
184P	1,298	1,088	1,193
44/W/34	879	1,479	1,179
Kenya Settler	933	1,341	1,137
261A	866	1,253	1,060
$291J_1l_1$	868	1,147	1,008
Sabanero...	331	779	555
Kenya Governor	No Crop...	—	—
Mean	858	1,289	—

Significant Differences. P=1·0 per cent varietal means 360 lb.
P=0·1 per cent for manure 192 lb.

This trial was conducted on a reddish grassland soil without a well defined humic topsoil and 5 tons of manure gave a very good response. Further work is required to find the most suitable variety as only Kenya Governor and Sabanero appear not to be suitable.

Maize.

TABLE 4

AT WANGINGOMBE

lb./acre

Variety	No Manure	5 Tons Manure	Mean
Eckstein...	1,009	1,885	1,733
Hickory King	1,227	1,548	1,550
Kenya Yellow	1,008	1,446	1,470
Local	1,048	1,818	1,630
Mean	1,073	1,675	—

Significant Difference. P=0·1 per cent for manure 228 lb.

Manure gave very appreciable responses for all varieties. The new varieties were no better than the local.

Groundnuts.

TABLE

AT WANGINGOMBE

Kernels, lb./acre

Variety	No Manure	5 Tons Manure	Mean	Days to Harvest
B.353	1,260	1,904	1,589	204
B.716	1,280	1,676	1,478	217
B.727	1,412	1,535	1,474	218
Gambia Bunch	1,180	1,651	1,416	218
Natal Common	1,190	1,576	1,382	218
Stephenville	1,220	1,478	1,348	218
BB2	931	1,598	1,264	204
Kongwa Red	902	1,159	1,020	218
Mean	1,172	1,572	—	—

Significant Difference. P=0·1 per cent for manure 180 lb.

Manure gave a valuable and highly significant increase in yield. The yields were all good. The local variety was grown in an adjacent observation plot and yielded 533 lb. of kernels per acre. Twenty-one varieties were grown in observation plots without manure but none yielded as well as the above varieties.

Grasses.

At Uwemba, a Danish and a Kenya type of Cocksfoot were sown at the beginning of January and in mid-February. Both established themselves well but the earlier planting date was clearly the better. Rhodes was also sown at the same times. Its early growth was promising but it dried off markedly soon after the rains stopped.

At Lupembe, Molasses grass did very well. It provided but little grazing in the first season but gave an excellent dense cover when the rains began again.

Other Crops.

Bitter White and Sweet Edible Blue No. 1 Lupins were planted at Uwemba. The Bitter White sown in January gave a magnificient bulk of green material and stifled all weed growth. The Sweet Edible was not so successful.

A plot of Linseed at Uwemba proved a complete failure.

Russian Comfrey did not produce well at Uwemba and Lupembe.

Pyrethrum

Introduction.

The season was reasonably favourable for pyrethrum growth and production and especially favourable for planting. Rainfall figures for Uwemba are given in the general section of the report on Njombe Field Experiments. Frosts were at no time severe enough to affect pyrethrum adversely.

Of the new experiments laid down this season, most interest was focused on a series of four micro-nutrient trials.

Summary of the Year's Work.

1. The second season of the Soil Type Trials has proved slightly disappointing in that there has been little real evidence of residual effect due to application of manure and phosphate at planting, and neither has addition of phosphate at the beginning of the second season given the results that were hoped for.

2. In South Uwemba on a non-ash soil type there has however been clear evidence of residual effect in the second season due to super-phosphate application at planting.

3. Micro-nutrient trials have not shown any pattern of response to any particular element or combination of elements.

4. Reno-Hyperphosphate has been found to be of equivalent value to super-phosphate as a fertilizer for pyrethrum.

5. Poultry manure applied to pyrethrum at planting has been found to give a residual effect in the second season.

6. Spray irrigation has again indicated that yield increases are obtainable from water application in September, October and November.

Experiments in Progress.

Soil Type Trials.—The treatments and results from the first year's picking were dealt with in last year's report. In this, the second season, it was decided to replace the mulch treatments, which had had no apparent effect in the first year, by the addition of super-phosphate at the rate of 50 and 100 lb. per acre. The super-phosphate (40 per cent P_2O_5) was placed in small holes between all plants in the plots receiving treatment : The object being to determine whether such application would give an additional boost to second season yield, either where phosphate had also been applied at planting or where it had not.

Results of these treatments showed no significant differences except on Bayldons Red where an increase in yield of about 150 lb. per acre was obtained for the 100 lb. extra application : On other soils there was not even any tendency towards significant response.

All plots were picked at monthly intervals from February to December and the following main effects were obtained from the treatments :—

TABLE 1: SOIL TYPE: TRIALS: 1956 MEAN YIELDS FROM PHOSPHATE TREATMENTS DRY FLOWERS, LB. PER ACRE

Soil Type	Superphosphate 40 per cent Applied at Planting.			Significant Difference at 5% P.
	none	100 lb./acre	200 lb./acre	
A. Pany's Ash	1,038	1,110	1,094	N.S.
B. Dathan's Ash	691	736	789	N.S.
C. Notcutt's Ash	672	675	642	N.S.
D. Togn's Ash	500	507	578	N.S.
E. Bayldon's Ash	590	610	762	92·0
F. Pany's Red	874	899	902	N.S.
G. Bayldon's Yellow	126	96	78	N.S.
H. Dansland Valley	277	252	313	N.S.

TABLE 2: SOIL TYPE TRIALS: 1956 MEAN YIELDS FROM PHOSPHATE TREATMENTS DRY FLOWERS, LB. PER ACRE

Soil Type:	Superphosphate (40 per cent) applied at beginning of 2nd Season.			Significant Difference at 5% P.
	None	50 lb./acre	100 lb./acre	
A.	1,050	1,100	1,092	N.S.
B.	729	753	733	N.S.
C.	703	641	645	N.S.
D.	521	537	527	N.S.
E.	609	600	754	92·0
F.	900	876	899	N.S.
G.	82	111	108	N.S.
H.	305	267	270	N.S.

TABLE 3: SOIL TYPE TRIALS: 1956 MEAN YIELDS FROM MANURE TREATMENT DRY FLOWERS, LB. PER ACRE

Soil Type:	Farmyard manure applied at planting: None	5 Tons/acre	10 Tons/acre	Significant Difference at 5% P
A.	972	1,101	1,169	102
B.	700	727	789	N.S.
C.	680	689	620	N.S.
D.	537	533	515	N.S.
E.	652	615	696	N.S.
F.	849	871	956	N.S.
G.	51	111	138	N.S.
H.	224	305	313	N.S.

No interaction effects were significant in the second season's yields.

The analysis for differences between soil types has again shown very clear cut distinctions between the yields from the eight soils. Also the differences between soils containing volcanic ash and those without it are highly significant. Soils growing their first crop of pyrethrum have again out yielded those which produced a previous crop.

TABLE 4: SOIL TYPE YIELDS 1956

Volcanic soils		Non-Volcanic soils		Significant Difference at 5 per cent P.
A.	1,081	E.	654	115 lb./per acre.
B.	738	F.	892	
C.	663	G.	100	
D.	528	H.	281	
Mean	753		482	58 lb./per acre.

"New" soils		"Old" soils (Pyrethrum produced previously)		
A.	1,081	C.	663	115 lb./acre.
B.	738	D.	528	
F.	892	G.	100	
H.	281	E.	654	
Mean	748		486	58 lb./acre

Conclusion From Second Season.

It does not appear as if the application of phosphate after the crop has been in the ground for a season has any effect on yield except on Bayldon's Red. Until this treatment has been repeated in the coming season no definite recommendation should be made.

The residual effects in the second season from the original application of super-phosphate and manure have, in the main, not been sufficiently marked to show significance. The 200 lb. level of super-phosphate application did however show an increase of over 150 lb. per acre on Bayldon's Red and both the 5 and 10 ton manurial applications showed increased yields of over 130 lb. per acre on Pany's Ash. These residual effects to phosphate have been generally less marked than in previous experiments where application rates of 150 and 300 lb. per acre were applied.

Differences between soil types have followed the pattern set by the first season's yield. There can be no doubt that soils containing volcanic ash are generally better suited to pyrethrum production in Uwemba, although what factors contained in the ash soils make them more productive is still uncertain.

A further point which has again been underlined in this year's results is the marked difference in yields obtained from soils which grew a previous crop of pyrethrum and those that did not. All that can be stated on this matter so far is that the fall off in yield once a soil has been put under cultivation for some years, cannot apparently be put right by phosphate or manurial application at the levels employed here. In any speculation on possible causes of this deterioration the loss of structure and powder-like quality found in the "Older" soils should not be overlooked. The answer to the problem may be found to be connected with the physical properties of the soils rather than with their chemical content.

Fertilisers and Manures.

A 3 × 3 × 3 factorial (superphosphate, nitro-chalk and mulch) experiment was picked throughout the season at monthly intervals. No further treatments were applied beyond those given at planting. First years results were discussed in last year's report and showed only a straight response to super-phosphate application.

This season, there has been a clear-cut residual response to the super-phosphate treatments. No other differences or interaction effects attained significance.

TABLE 5. MEAN TREATMENT YIELDS IN LB. OF DRY FLOWER PER ACRE

Treatment	1955	1956	Total
No supers	155	808	963
150 lb. Supers/acre (40 per cent P205)	245	946	1,191
300 lb. Supers/acre	280	985	1,265
Significant difference at 5 per cent P.	30	58	78
No Nitro Chalk	235	917	1,152
150 lb. Nitro Chalk per acre	230	901	1,131
300 lb. Nitro Chalk per acre	220	920	1,140
Not Significant			
No Mulch	235	934	1,169
Light Mulch	225	913	1,138
Heavy Mulch	215	891	1,106
Not Significant			

In all 3 analyses differences between phosphate treatments were significant at the 0·1 per cent point.

Response to super-phosphate at the 150 lb. level has been the most striking factor to come from this trial. Over the 2 seasons a total increase in yield of 228 lb. per acre has been obtained from this application.

The application of 300 lb. of super-phosphate also increased yield above the lower application level, but the total return for the second 150 lb. was only 74 lb. per acre which was not quite significant.

It appears therefore that an application of between 100 and 200 lb. per acre of super-phosphate will give the best economic return on this soil. This trial has shown no indication of any advantage in applying nitro-chalk or mulch.

An experiment was planted to discover what differences in yield occur in a second pyrethrum cropping cycle compared with the first. This is an identical repetition of an experiment carried out from 1950-53 on pyrethrum grown as the first crop when the land was newly broken. The plots and treatment were all repeated in exactly the same position with the exception of the lime applications. No fresh lime was applied this time, and any effects shown would be residual from the applications in 1950. In 1954 and 1955 the area was resting under a poor grass ley.

The experiment was planted on 22nd January and harvesting began in May. By the end of the year the following total yields were obtained (figures for 1950 are included for comparison).

TABLE 6. SECOND CYCLE FERTILIZER EFFECTS: (YIELDS PER ACRE IN LB.)

	1956 (first season)		1950 (first season).	
No Phosphate	289	...	662	
150 lb. Super (40 per cent P_2O_5 ...	288	N.S. ...	697	
300 lb. per acre	309	...	838	significant at 1 per cent.
No lime	292	...	777	
2 tons Lime in 1950	286	N.S. ...	700	N.S.
4 tons Lime in 1950	302	...	725	
6″ Spacing	323	...	842	significant at 1 per cent.
9″ Spacing	281	N.S. ...	695	
12″ Spacing	276	...	660	

A further year's results are needed from this trial before any conclusion will be put forward. The very considerable difference in yield between the two "first season" crops needs no emphasising, but the reasons for the deterioration are not yet obvious without resort to such unsatisfactory terms as "soil exhaustion" and "loss of inherent fertility".

A $3 \times 3 \times 3$ factorial (super-phosphate (40 per cent), poultry manure, and Reno hyper-phosphate) experiment was planted on January 6th. All fertilizer treatments being placed below the plants at planting.

Mean treatment yields did not show any significant differences this season and a further season's yields are required before any conclusion can be drawn.

TABLE 7. MEAN TREATMENT YIELDS: PHOSPHATE COMPARISON—LB. DRY FLOWER PER ACRE

	Yield	
No super-phosphate	379	
150 lb. per acre supers (40 per cent P_2O_5	431	N.S.
300 lb. per acre supers (40 per cent P_2O_5	438	
No poultry manure	446	
150 lb. per acre poultry manure	438	N.S.
300 lb. per acre poultry manure	363	
No Reno hyper-phosphate	405	
150 lb. per acre R.H.P.	408	N.S.
300 lb. per acre R.H.P.	435	

The subsoiling and poultry manure experiment was retained for a second season to determine the residual effect of the original poultry manure applications.

TABLE 8. MEAN TREATMENT YIELDS—LB. OF DRY FLOWERS PER ACRE

Treatment	1955	1956	Total
No poultry manure	156	608	764
P.M. at 200 lb./acre	204	650	854
P.M. at 400 lb./acre	231	677	909
Significant difference (5 per cent) ...	34	N.S.	143

The following analysis of the poultry manure used was supplied by the Government Chemist :—

	%
Moisture	7·3
Loss on Ignition (organic matter)	37·5
Total Nitrogen	1·33
Total P_2O_5	4·76
Total K_2O	1·17

Over the two year period from planting it appears that an application of 200 lb. of poultry manure will give an additional yield of about 50 lb. per acre in the first year with a doubtful residual effect in the second season. The 40 lb. application gives about 75 lb. increase in the first season and about 140 lb. increase over the first two seasons.

TABLE 9. RENO HYPER PHOSPHATE TRIALS.—LB. OF DRY FLOWERS PER ACRE

Treatment	1955	1956	Total
270 lb. R.H. Phosphate	230	295	526
200 lb. super	229	278	508
200 lb. R.H. phosphate	164	291	456
150 lb. supers	239	211	451
130 lb. R.H. phosphate	176	292	468
100 lb. supers	168	262	430
No fertilizer	156	254	410
Significant difference P=5 per cent ...	68	N.S.	N.S.

The experiment comparing super-phosphate (40 per cent P_2O_5 and Reno-phosphate (30 per cent P_2O_5) was picked for a second year. No significant residual effects were found.

Reno-Hyperphosphate is undoubtedly a useful phosphatic fertilizer for pyrethrum in the Uwemba area, and there is some slight indication in this trial that its effect may be more lasting than that of superphosphate. At present prices however there is practically no difference in the yield increase per unit of cost between the two fertilizers.

In South Uwemba a series of four trials was undertaken to determine phosphate responses and to investigate the difference in yield where either seedlings or splits were used. So far as the planting material aspect of the trial was concerned, no significant differences appeared between the yields of seedlings and splits.

In their first season all four trials were unfortunately not sufficiently accurate to give any definite information on the question of phosphate application. In the second season standard errors were reduced down to a

reasonable level for residual effects to be estimated on three of the trials. On two of these there were no residual significant responses, (a dark loam containing volcanic ash, a valley soil containing volcanic ash). On a black forest soil with volcanic ash overlaying red granitic subsoil, there was a marked residual effect as is shown in the following table :—

TABLE 10. PHOSPHATE REQUIREMENTS: SOUTH UWEMBA—LB. OF DRY FLOWERS PER ACRE

Treatment	1955	1956	Total
No superphosphate	39	275·6	315
150 lb/acre supers (40 per cent) ...	120	357·0	477
300 lb./acre supers (40 per cent) ...	118	365·6	484
600 lb./acre supers (40 per cent) ...	116	396·7	513
Significant difference P=5 per cent ...	79	38·3	90·1

The irrigation trial was continued. This season spray irrigation at the rate of two inches per acre per fortnight was not begun until the first week of September. This was because last year's trial had shown no response to irrigation in earlier months.

Plots were then picked in September, October, November and December. The total of these pickings gave a treatment yield for the irrigated plots of 154·3 lb. of flowers per acre and for the non-irrigated plots 117·7 lb. per acre. This difference was significant at 0·1 per cent and a significant difference at 5 per cent is 19·0 lb. per acre.

Although this season's response to water was not as high as last seasons' (76 lb. per acre) there is no doubt whatever that irrigation, especially from August to November, increases yields quite substantially. This trial has only been conducted on a very small scale and the whole question of irrigation should be looked into in more detail and on a costings basis.

Micro-nutrient Trials.

With the help and advice of the Government Chemist trials with zinc, boron, molybdenum bion, manganese, copper and sulphur alone and in various combinations were laid down in conjunction with basic treatments of phosphate, nitrogen and lime. The treatments were not replicated at any one site. No evidence was obtained that any treatments other than the basic treatments had any effect on yield.

J. R. Tuckett,
Agricultural Officer

REGIONAL RESEARCH CENTRE, NACHINGWEA

PLANT BREEDING

The following table gives a summary of the monthly rainfall totals for the 1955-56 season.

		Inches	Days	Average for 8 years, Inches
1955	December	4·52	10	—
1956	January	10·34	20	7·82
	February	4·65	18	7·82
	March	7·10	20	6·14
	April	10·86	20	6·03
	May	1·26	6	1·03

Effective rains began in mid-December, 1955 and continued until early May. The February total is below average but in this month the weather continued to be overcast, with frequent showers. There was no pronounced drought period during the season and the total was well above average.

Soya bean.

General.—The aim in soya breeding and selection has been a high yielding variety suitable for combine harvesting. The varieties MIS28EB, Hernon 237 and Malaya, at present being grown on Tanganyika Agricultural Corporation production farms are fairly satisfactory, but sometimes produce very rank growth which often lodges badly and is difficult to harvest. These varieties have the "indeterminate" habit of growth, with as many pods on side branches as on the main stem. A strain of "determinate" growth habit (pods clustered thickly on the main stem with few side branches) with at least 6 inches between ground level and the first cluster of pods, would be easier to harvest. Non-shattering would also be an asset.

Two main types are now being sought :—

(a) High yielding, non-shattering, determinate in habit, with pods formed 6 inches above ground level, for mechanical harvesting.

(b) High yielding, non-shattering but with no qualification as to habit for hand harvesting by the African peasant.

Selection.—Selections have been made from Hernon 237 and MIS28EB, both of which contain a mixture of types. These have been grown in progeny rows, and the best retained for testing in a strain trial during the next season. It is hoped to obtain an "Improved Hernon" or an "Improved MIS28EB" from this material.

Individual plant selections were made from Malaya and Benares and these will be grown in progeny rows next season.

Hybridisation.—Various inter-varietal crosses have been made. In most cases the cross has been made between a tall, long season combinable variety with indeterminate habit (i.e. Hernon 237, Malaya, MIS28EB, Benares) and

a dwarf short season type of determinate habit (i.e. R. 184, Light Speckled, Glycine Ruggett). CNS, a variety of intermediate type (fairly long season, rather dwarf, but possibly suitable for combine harvesting) has also been used in the breeding programme.

Each cross is being harvested in bulk until the F4 generation, when individual plant selection will be made. The plants are at present in the F3 generation.

Sunflower.

General.—Work with this crop has been confined to the variety "West Nile". It is evident that this variety is well adapted to conditions at Nachingwea: bulk crops on production farms appear extremely promising. West Nile sunflower in Nachingwea is a mixture of many types. The seed is predominantly white, but many heads have seed with grey stripes. Many plants are multiheaded. Height varies from about 4 ft. to 12 ft. or more. In the past difficulty has sometimes been experienced with pollination. With small plantings near the edges of fields, the bee population is usually sufficient for almost 100 per cent seed set: in large areas of sunflower however many of the seed are found to be empty.

The objects of work with West Nile Sunflower are:—

(a) The selection of strains with a high degree of self-fertility.
(b) The elimination of all seed colour other than white.
(c) The selection of strains of uniform height (6-8 ft.) with no multiheaded plants.
(d) Improvement on the yield of the present unselected material.

Breeding and Selection.—Work was started early in 1955 and a number of plants selected which set a fair proportion of good seed under bags. In most cases selections were single headed plants: a few however had some axillary flowers. The progeny of these selected partly self fertile plants were grown in the 1956 season and were again selfed. Nine lines were retained from the second generation of selfing, as showing a certain amount of self fertility, being plants with good head size, without axillary flowers and with white seed.

Seed from these nine lines was grown under irrigation at Nkumba during the dry season, for the third generation of selfing. All the plants have not yet been examined, but so far it does not seem that inbreeding and selection have brought about any considerable increase in self fertility. Inbreeding and selection may however be worth while even if self fertile lines cannot be found. The elimination of multiheaded types of plant for example would be very desirable.

It is intended after four or five generations of inbreeding, that the selected lines should be tested for "combining ability" using a process similar to that suggested by Lonnquist for maize. Those with the best "combining ability" may then form the nucleus stock of an "Improved West Nile".

Meanwhile, fifty seeds from each of the nine lines, after two generations of selfing, were mixed together and planted in isolation and allowed to cross freely,

to form the basis of a "Synthetic II". This was repeated with parent seed from the same lines after one generation of selfing—to form a "Synthetic I". These two Synthetics will be put into trial with parental West Nile next season. It is probable that "Synthetic II" will be of use for issue to farms as a primary "Improved West Nile" variety. "Synthetic I" will be of interest to compare with "Synthetic II" and future Synthetics III and IV—an indication as to how many generations of selfing are necessary to remove "genetic rubbish" and retain sufficient vigour.

Sorghum.

General.—Sorghum is an important crop in the Southern Province, and varieties with high quality grains are grown regularly by the people. Bird damage is unimportant and the goose-neck bird resistant character is not required here as it is in the Lake Province. From the African farmers' standpoint, the major requirements are shorter straw and higher yield: earliness of maturity may be an advantage in allowing of later planting. From the Tanganyika Agricultural Corporation standpoint a high quality high yielding type, suitable for combine harvesting is needed.

Selection.

Three "White" Dobbs selections from fields of ordinary Red Dobbs were tested in a trial against other varieties. The yields obtained were:—

White Dobbs II	1,797 lb. per acre
Red Dobbs	1,741 lb. per acre
White Dobbs I	1,099 lb. per acre
White Dobbs III	1,068 lb. per acre
SUK I	881 lb. per acre
Swaziland P41	571 lb. per acre
Sign. Diff. P=0·05	315 lb. per acre
P=0·01	432 lb. per acre

White Dobbs II and III are now being grown on Tanganyika Agricultural Corporation production farms.

Hybridisation.

(1) Swaziland P41 × "UK" strains obtained from Ukiriguru.

The object of this cross was to obtain a high yielding, white seeded variety suitable for combine harvesting. Twenty-two lines were retained from the F4 generation grown this season. These were bulked in the F5 generation, under irrigation, during the dry season, and the seed will be put in an orthodox strain trial during the 1957 season. These lines are superior to the Swaziland P41 at present being grown with regard to uniformity, height strength of straw and probably yield, but the grain is non-cornaceous. It is hoped that one or more of these strains will be of use to farms as a short term policy until cornaceous grained types are available. They will be of application only within the Tanganyika Agricultural Corporation area, as the local people are unlikely to show an interest in soft, white grained, poor storing types when their own (i.e. Msumbiji and Lionja) are so good.

(2) Swaziland P41 × SUK I.

The object of this cross was to obtain a high yielding white cornaceous grained strain, but the results are not as good as had been hoped. Many lines have good cornaceous grain but have small heads, weak stems and are far from uniform. A few of these lines together with progeny from the Dobbs × (Dobbs × Wiru) cross will be carried further with the hope of obtaining high yield with good grain, but the best material is likely to come from the Msumbiji crosses being produced at Ukiriguru.

Further hybridisation of sorghum at Nachingwea has stopped and future policy is to sift and reselect within material ex-Ukiriguru aiming at a group of varieties of differing maturity lengths but all with good grain quality, high yielding and short straw.

Cashew.

Methods of vegetatively propagating the cashew tree have been tried in the past at Nachingwea. Cuttings, budding and grafting have all proved unsuccessful.

Air-layering of cashew was tried during the 1956 dry season, using sawdust and Vermiculite as absorbent materials. Water and "Hortomone A" solutions were used to saturate the materials. Sixty per cent of the air-layers have formed roots, the failures being largely due to mechanical faults—the drying up of the moist material, splitting of the polythene bag, etc.

There seems to be no difference in using either sawdust or Vermiculite as absorbents or in using water or "Hortomone A" solutions, but more precise experiments need to be carried out to ascertain this.

An air layering method recommended by May and Baker Ltd. for shrubs in England, using their Hormone powders Seradix L15 and L30, has not been successful as yet.

The air layers produced by the Indian method have not as yet been planted out, but it does seem that the method will prove successful. It is likely to be of great importance to the Cashew industry if high yielding trees can be propagated.

The task remaining is to find the high yielding trees. Work in Jamaica has shown that selection of high yielding trees is possible. Yields from individual trees in a plantation at Nachingwea have been recorded for three years. Twenty of the trees gave high yields for both 1954 and 1955 season, but the 1956 yields show no correlation. It is probable that attempts to improve the crop must await a practicable method of controlling *Helopeltis*, whose effect is so devastating on young trees.

A. K. Auckland,
Botanist

REGIONAL RESEARCH CENTRE, NACHINGWEA

ENTOMOLOGY

Cashew.

The major entomological problem in the Southern Province is concerned with the two mirids, *Helopeltis bergrothi* Reut. and *H. anacardii* Mill, causing a serious die-back of the young shoots of cashew.

Young trees are more severely affected than older ones and although they are seldom killed, severe stunting may take place which has an adverse effect on the future shape of the tree, besides setting it back.

Dusting trials, with 0·5 per cent BHC dust, which have been carried out under the direction of the Entomologist, Morogoro, at Mkunya Leprosarium in Newala District, show that these insects have quite a marked effect in reducing nut yield.

Work in the coming year will be concerned mainly with the biology of the two insects both on cashew and on other host plants.

Other Crops.

Flea beetle, *Aphthona bimaculata* Jac. on sesame, and Central-shoot fly of sorghum, *Antherigona indica* Mall. are reported to be the most important insect pests, after *Helopeltis,* to found in the Southern Province.

The former is controlled by the application of a dust containing 5 per cent DDT and 3 per cent BHC.

Storage Pests.

A search for the Khapra beetle, *Trogoderma granarium* Everts, was carried out in the coastal areas of Tanganyika. The survey covered the port areas of Dar es Salaam, Lindi and Mtwara as well as warehouses and stores in the towns themselves.

A heavy infestation of *T. granarium* was found in Lindi in a consignment of cowpeas, and was successfully fumigated.

Later the survey was extended to include eight villages in the Mtwara, Lindi and Masasi Districts whose markets supply Lindi and Mtwara. No further *Trogoderma* were found, so it must be supposed that the outbreak was an isolated one.

Groundnuts and to a lesser extent sunflower seed, were almost invariably infested with *Tribolium castaneum* Herbst. and larvae of *Ephestia* spp. Not much maize was seen, but what little was present was heavily attacked by *Calandra oryzae* L. Groundnut oilcake harboured *T. castaneum* and also occasionally, *Lasioderma serricorne* F. Beans showed widespread infestation by Bruchids.

M. Bigger,
Entomologist

MAHIWA RESEARCH STATION

Weather.

The rains began in the middle of January except for a small amount that fell during the last two weeks of December. Heavy rains towards the end of February partially broke down ridges and washed out seedlings in some places. April rainfall was high and caused water-logging which retarded growth.

	Inches	Days	10 year Average Inches
1955 December	2·34	7	3·45
1956 January	8·63	15	6·23
February	10·08	16	7·01
March	10·12	14	6·21
April	11·90	21	6·98
May	1·87	7	0·39
	44·94		

General.

The yield of velvet beans was almost double that of last year, 800 kg. per acre. Mean yields of sorghum varieties were approximately the same in both years, 374 and 361 kg. per acre, but the yields of individual varieties varied more widely. Dobbs and Msumbiji yielded better than in 1955 but yields of Combine Waxy Kaffir, Lionja and Enyanza were lower. The year was a difficult one for establishing sorghum owing to heavy rains at planting time and so Dobbs and Msumbiji may have stood up to such conditions better than the other varieties. Sesame yields were also reduced, again due to heavy rains washing out seedlings and washing off insecticide applied to control flea-beetles.

Experimental Results.

Sorghum, var. Msumbiji.—A factorial N.P.K., experiment testing 1 cwt. per acre of sulphate of ammonia, double superphosphate and muriate of potash, with an extra treatment of 5 tons of farmyard manure per acre, placed and broadcast, was planted. The average yield was 1,110 lb. per acre, phosphate gave a response of 295 lb., significant at the 5 per cent level. The N.K. interaction gave a significant positive response of 277 lb., but the N and K responses, 15 and 198 lb. were not significant. Placement of fertilizers had no effect. Five tons of manure gave a response of 1,200 lb. over that of the nil treatment, 413 lb. In this instance placement had a marked effect, placed manure giving 2,354 lb. and spread manure 1,426 lb. per acre. Residual effects will be investigated next season.

Spacings varying from 6 to 24 inches had no significant effect on yield.

Maize, var. Katumbili.—Neither fertilizers nor farmyard manure improved yields on a poor sandy soil.

Sesame.—A mixture of sulphate of ammonia and superphosphate increased yields significantly by 184 lb. over a poor crop of 64 lb. per acre without fertilizer. Ten tons of farmyard manure increased yields by 97 and 176 lb. in the presence and absence of 1 cwt. per acre of sulphate of ammonia.

Top dressings of sulphate of ammonia did not significantly increase yields.

Oil Palm.—Comparative observations on the yields of two varieties have continued.

	Fruit, lb. per tree		Oil, lb. per tree	
	1954-55	1955-56	1954-55	1955-56
Pedigree	32·1 ...	37·1 ...	1·0 ...	2·3
Deli	20·2 ...	24·6 ...	0·7 ...	1·1

W. H. Andrews,
Agricultural Officer

COFFEE RESEARCH STATION, LYAMUNGU

SUMMARY REPORT

Weather.

After light rain during the latter half of December, 1955, a record amount of 7·22 inches was recorded in January, 1956. Little effective rain fell in February, but the distribution in March was adequate. The long rains began with a two-inch fall on April 11th and apart from a dryish spell in mid-April, were reasonably well distributed. The total fall was low, amounting to 25·49 inches. Unusually hot, sunny afternoons were frequent towards the end of April and during May. The next three months were cool and in the main dry, the total rainfall recorded during this period being 5·57 inches. Apart from two effective showers near the end of September, the dry weather continued for the next two months. The last quarter yielded 2·58 inches, of which only 1·4 inches could be considered as effective rainfall, and this was spread over three days early in November. The year's total was 45·10 inches.

Crop.

There were three main flowerings. The first took place during the last half of November, 1955, the second near the end of December, 1955 and the third in the middle of January, 1956. An exceptionally heavy crop was set over much of the Station, and by the end of March a large proportion of the cherry had reached an advanced stage of maturity. Even at this early stage a number of trees had begun to show signs of strain due to the heavy crop which began to ripen in quantity abnormally early. Picking was commenced in June and the peak reached in August-October instead of September-November as is more usual; the stripping of certain areas had to be started in July. Including seed, but excluding buni, cherry equivalent to about 99 tons of parchment was picked. The area in bearing was 136·5 acres.

Station Experiments—Coffee

Improvement of Planting material.—A new seedling selection trial (Experiment XXVII), testing sixty selections, was planted in April. The poor rainfall and hot sunny afternoons caused difficulties in establishment, but by the end of the year there was a good stand and reasonable growth had been made.

After the comparatively heavy crops of 1955 in Experiment XVIII (clonal selection trials) severe infection with leaf rust, *Hemileia vastatrix*, occurred again early in 1956. The biennial bearing cycle was again much in evidence, the yields varying according to the amount of crop borne in the preceding year.

Severe die-back, culminating in death in some instances, occurred in the weaker clones in Experiment XVIIIA, especially in the sub-plots pruned on the multiple stem system. One of the worst affected was the clone N.101. Just under an estimated* 12 cwt. per acre of ripe coffee was harvested from

*Here, and in all other instances where 1956 yields are mentioned, the clean coffee figure for both ripe coffee and for strippings have been calculated using an arbitrary conversion factor of 16 per cent clean to cherry.

Differences in yield quoted in this report have not yet been subjected to significant tests.

the multiple stem trees of this clone, following a yield of 10 cwt. in 1955; strippings from these were the equivalent of a potential 14·9 cwt. of clean coffee per acre. In the same square F.840, a stong grower, yielded approximately 22½ cwt. on multiple stem and over 17 cwt. in 1955; strippings amounted to a potential 4·2 cwt. clean coffee per acre only.

Similarly in the other square, N.229 and AC.83, both weak clones, each yielded just under 15 cwt. of ripe coffee, while strippings amounted to the equivalent of a potential 11·7 cwt. and 13·1 cwt. per acre of clean coffee respectively; 1955 yields were 11·86 cwt. and 12·17 cwt. respectively. A vigorous clone for comparison here is KP.265, which yielded approximately 25 cwt. of ripe coffee and strippings equivalent to a potential 1·2 cwt. after a yield of 18·34 cwt. in 1955.

The first crop was harvested from Experiment XXIV (seedling selection trial planted in April, 1954), and some very heavy yields for a first crop were recorded. Each selection is represented on both the single and multiple stem systems; an unusual feature has been the higher yields from the single stem trees were in a good condition at the end of the crop season. The multiple of the crop was borne on branches arising from below the first capping in both cases. Most of the yields were between 12 and 16 cwt. of clean coffee per acre, but X.321 on single stem bore over 19 cwt. of clean coffee per acre, derived solely from ripe cherry.

There has been die-back, and some deaths, throughout this experiment, and the "bottled" condition referred to later in Experiment XXIII is also to be found in this experiment. In addition, a die-back of an unusual type occurred at the beginning of the year in a roughly circular patch involving some twenty-five coffee trees. Cultures of a fungus isolated from the affected plant tissue were identified as *Glomerella cingulata*. The symptoms have not appeared elsewhere, nor have they spread to other trees outside the initial centre of infection.

Another good crop was again harvested from Experiment IIIB planted in April, 1951, with one-year-old material; the yields from this experiment for the last four years are as follows :—

Yields expressed as cwt. clean coffee per acre

	1953	1954	1955	1956 (estimated)	Mean
A. Clone	11·51	17·68	19·55	23·19	18·01
B. Seedling of Orginal Parent ...	7·87	21·03	17·17	24·25	17·58
C. Seedling of Clone	7·02	20·44	13·85	25·23	16·64
D. Second Generation Seedling ...	6·64	21·98	16·15	24·26	17·26
H. 39	8·69	21·96	17·47	24·69	18·20
H. 66	8·43	19·86	15·67	24·17	17·03
N. 5	7·66	19·03	16·91	23·93	16·88

Pruning in this experiment has been confined to the thinning-out of the lower branches only. Small step-ladders were successfully used for the harvesting of the crop from the tall trees.

The variety collection was further extended by the addition of eleven new introductions.

Cultural Experiments.—Yield records were again taken for the purpose of assessing the residual effects of treatments in Experiment V (elephant grass mulch, compost, and sulphate of ammonia) and in Experiment XIVA (mulches, compost and sulphate of ammonia). In the later experiment, five years after the application of treatments was discontinued, the residual effect is still marked.

In Experiment XIX (interplanted bananas with and without manure), there was no difference this year between the plots with interplanted bananas and those without bananas. This is a continuation of the trend which started last year when the differences were very slight and not significant. The first three cropping years showed a marked depressing effect on yield by interplanted bananas.

The first year's results from Experiment XXIII (spacing with interplanted bananas) are in agreement with this earlier finding. Interplanted bananas at the rate of 180 to the acre have depressed yields by approximately 28 per cent.

As regards the spacings, increased yields have been obtained up to a density of 2,160 plants to the acre (4½ feet by 4½ feet). It is interesting to note that a square planting has given a greater yield than the same population planted in double rows.

As the season progressed the incidence of die-back increased; it was particularly noticed that in some instances the leaves wilted and died without falling. Further investigation in this experiment (and elsewhere on plants of a similar age or younger) revealed a hitherto unknown condition in coffee. The symptoms are a somewhat swollen condition of the main stem, some 6-9 inches above ground level; above the swelling the stem gradually tapers down to the normal thickness, giving a bottle-like shape to the lower portion of the main stem. The bark is found to be unduly thickened and the wood ridged and pitted at the point of swelling. After enquiry and the submission of a full description, a similar condition has been discovered in Brazil and on a few trees in Kenya. The Plant Pathologist is investigating the matter.

Heavy stripping, commencing in July, was necessary in all treatments of Experiment XV (irrigation and mulch). This complicated the evaluation of the results, but it can be generally stated that mulch has effectively increased yields and has enabled a greater proportion of the crop to be ripened.

Pruning Experiments.—High yields were recorded in Experiment XXI (comparing methods of establishing the single stem system and methods of establishing the multiple stem system). Both the single stem treatments have produced estimated yields of approximately 25 cwt. per acre, following comparatively low yields of between 6 and 7 cwt. per acre in 1955. These trees were in a good condition at the end of the crop season. The multiple stem treees however, especially those with two stems, showed a considerable amount of die-back after yielding an estimated 33·5 cwt. and 31 cwt. following yields of 16·02 and 10·46 cwt. respectively in 1955. The first yield on the trees pruned according to the Colombian system was an estimated 14½ cwt.

The advantage of retaining a "skirt" for at least the first two cropping years was shown in the second bearing year of Experiment XXII, where the treatment without a "skirt" yielded nearly 7 cwt. less than that where the "skirt" had been retained from the start. There was a similar loss of over 4 cwt. in the first bearing year. By capping two stems to make four, production of bearing wood has been retarded with a resultant loss of crop amounting to approximately 3½ cwt. per acre in the second bearing year. Similarly, in the single stem system where the development of the second storey was delayed for 6-9 months, there was a loss of 2-2½ cwt. per acre.

Miscellaneous Coffee Experiments.—The possibility of rejuvenating old coffee by pruning is being investigated and compared with that of uprooting and replanting in Experiment IB. This was started in 1955 and good growth has been made during the current year. It is particularly interesting to note that it is possible to develop a strong new shoot on the single stem system from the base of an old stump, but two cropping years must inevitably be lost in the process.

An experiment (XXIX) was carried out to test the effect on transplanting, and subsequent growth, of leaf and root treatments. The leaf treatments consisted of trimming and the application of plastic spray, both by spraying and dipping, at the time of transplanting to the field. None of these treatments materially assisted in the transplanting survival rate under the conditions of the experiments, which were severe. One of the root pruning treatments, however, was very successful in maintaining a very high survival rate among the transplants. In this treatment, the tap-root was under-cut in the nursery, at a depth of 9 inches, five times at monthly intervals prior to transplanting. The effect was to eliminate (at least temporarily) the tap-root and cause an increased development of the lateral roots immediately above the cut. Planting was made very much easier with the type of root system, and little or no wilting occurred. It remains to be seen how the root systems of such plants will develop and how they will behave under strain of a heavy crop.

Nurseries

Cuttings.—Material was taken for use as replacements of casualties in existing experiments.

Seedlings.—Seed of several selections was sown for a projected fertilizer trial. Considerable damage was caused by cut-worm and by "damping-off" disease. The initiation of adventitious roots in the mulch above the point of damage occurred on a few seedlings: this is the first recorded instance at this Station.

Grafts.—An experiment was laid down at the end of the year to ascertain whether the "bottled" or pitting condition of coffee in Experiment XXIII could be transmitted by grafting. Three hundred scions from affected tree and three hundred from apparently healthy seedlings were bench-grafted on to apparently healthy seedling root-stocks and planted in glazed propagating frames. The cleft graft was used in all cases. Early indications show the probability of a very high percentage number of "takes" in the controls, but mortality of the scions from affected trees has been heavy. Re-grafting of these with scions of younger wood has been carried out.

Breeding.—Seed resulting from the crosses made in the 1954/56 season was sown in the nursery, but germination was again poor.

Further crosses were made during the 1955/56 season, but the amount of fruit set was low.

Seed.—Once again there was a big demand for seed. Some 4,750 lb. seed had been supplied by the end of the year. The manufacture and installation of a seed grading machine produced a more uniform product, but hand-picking was still necessary.

Pests and Diseases

White Stem Borer (Anthores leuconotus).—Coffee in the lower areas of the Station was again sprayed with Dieldrin over the bottom 18 inches of stem in March and again in November. The area was further extended in the latter spraying as some borers were found in hitherto untreated experiments. The original borer areas of the Station have been treated with Dieldrin regularly twice a year for the past three years and are now apparently free of borer.

Antestia (Antesia lineaticollis).—A build-up was indicated after the rains, particularly in the northern part of the Station. Control was effected by incorporating DDT in the post-rains copper spray.

Thrips (Diathrothrips coffæ).—Small out-breaks occurred at the beginning of the year and again in some of the young coffee in October. Spraying DDT was an effective control.

Leaf-miner (Leucoptera spp.*).*—A bad infestation occurred in the young coffee of Experiments XXIII and XXIV in October. Subsequent irrigation brought out new leaf.

Green scale (Coccus africanus and *Coccus viridis).*—Only isolated out-breaks on young coffee occurred.

Coffee Berry moth (Thliptoceros octoguttalis et al.)—Damage to young cherry was fairly extensive in April.

Leaf rust (Hemileia vastatrix).—Severe infection, followed by heavy leaf-fall occurred in parts of the Station early in the year, more particularly in Experiments XVIII, II and P.D.I., all fairly heavy shaded areas. The routine pre-rain and post-rain spraymgs with copper did little to arrest the progress of the disease and were presumably applied too late. Acting on this supposition, an additional spraying was inaugurated this year in December in areas where new leaf had already appeared.

External Trials.—Very heavy yields were again recorded in the selection trial at Mbosho (altitude 3,700 feet). N.197 was the highest for the year on both multiple and single stem, giving an estimated 35 cwt. and 22 cwt. clean coffee per acre respectively. KP. 423, which has tended to lag behind hitherto in this trial, also showed considerable improvement, yielding an estimated 29 cwt. and 20 cwt. clean coffee per acre on multiple and single stem respectively. There was a slight falling-off in the case of the previous three best selections, 1/255, N.173, and H.1, but even so a good high average was maintained. 1/255 maintains its position as the highest yielder over the 3-year period with yields

of approximately 25 cwt. and 14 cwt. clean coffee per acre on multiple and single stem respectively. In all cases trees pruned on the multiple stem system outyielded those on single stem by a considerable margin. In general vigour and girth most of the trees in this experiment have the appearance of trees of 15-20 years old, instead of the actual 5 years in the field.

At Mwika, on the other hand, the soil is different, the altitude is 1,000 feet higher, irrigation is not possible, and the growth rate is much slower. This trial is a replicate of that at Mbosho, yet here the highest yielder over the 5-year period (again the clone 1/255) has produced approximately 9 cwt. and 10 cwt. clean coffee per acre only on multiple and single stem respectively. It is also interesting to note that at Mwika the single stem trees have generally out-yielded the multiple stem; there was considerable leaf-fall and die-back this year in the case of the latter. A potash deficiency is suspected at Mwika.

At Arusha, where conditions are probably drier and the altitude an intermediate one, yields have been even lower. Here again the general pattern has been in favour of single stem trees.

F. R. Sanders,
Senior Research Officer

PLANT PATHOLOGY, LYAMUNGU

LABORATORY AND FIELD INVESTIGATIONS

The following new records for the territory were noted :—

Coffee : Stem-pitting—?Virus.
Cotton : Wilt—*Verticillium dahliae* Kleb.
Lucerne : Leaf spot—*Cercospora zebrina* Pars.
Tobacco : Scab—*Septomyxa affinis* (Sherb.) Wollenw.
Gladiolus : Storage Rot—*Penicillium gladioli* McCulloch & Thom.

Investigational work and disease situation in the territory:

Bananas.—Very few cases of wilt *(Fusarium cubense)* have been reported. One new outbreak was noted from Morogoro.

Halo blight (Pseudomonas phaseolicola).—This is probably the most serious disease of beans in the territory. Long rotations are necessary to reduce the level of soil infection. Promising results have been obtained with Agrimycin sprays but in view of the cost of these, spraying would have to be confined to foci of infection to stop further spread. The use of Agrimycin for seed treatment was not tried owing to reports that it tended to damage seed coats. New techniques now make this worth investigation.

Anthracnose (Colletotrichum lindemuthianum).—The level of anthracnose infections was very low in 1956. No investigations were made on this disease.

Mosaic (Bean Mosaic Virus).—This disease was present everywhere but nowhere causing much damage. There appears to be little spread by contact in the field and the insect vectors (aphids) have not been noticed to any great extent.

Angular spot (Isariopsis griseola).—No serious cases were noted but when severe complete destruction of the crop may ensue.

Rust (Uromyces appendiculatus).—1956 was a bad rust year and caused two crop failures within the susceptible variety, Dutch Princess. It is considered that it would pay to spray with copper or sulphur fungicides for the control of rust and also anthracnose and angular spot.

"Oily pod" (?Virus).—"Oily pod" symptoms were again noted at several places. Recent literature suggests that the leaf, stem and pod symptoms associated with various strains of Bean Mosaic virus and Bean Yellow Mosaic virus bear some resemblance to "oily pod". There is an urgent need for the clarification of the bean virus diseases.

Coffee.

Rust (Hemileia vastatrix).—Preliminary investigations into this disease have now begun. It is generally considered in the Northern Province

of Tanganyika that spraying with copper fungicides does not provide adequate protection against against rust. This may be a result of (a) spraying at the wrong times or (b) may indicate that copper fungicides are not effective against the strains of rust present in this area.

Weekly records have been taken since August of the intensity of rust on selected trees. These will be continued throughout the year and it is hoped to determine the epidemiology of the disease from these records. This will give a better indication of the time at which protective sprays should be applied.

A range of the newer fungicides, including organics and antibiotics have been tried against rust using detached inoculated leaves in petri-dishes. This technique has not been found satisfactory as the leaves do not remain alive sufficiently long (5 weeks) for the development of rust pustules. The trial is being repeated using coffee seedlings.

Stem-pitting (?Virus).—An unusual condition became apparent in some of the young Lyamungu coffee plantings in mid-1956. Extensive die-back and general decline did not follow the usual pattern of over-bearing die-back; the leaves in many cases remained on the trees after the branches had died back. Examination of the roots, stems and young leaders failed to reveal any fungal or bacterial pathogens. Later it was noticed that the basal portion of the stems on affected trees was swollen and assumed a "bottle-like" shape. The bark in this region was thickened and when removed, deep pits and furrows were found in the underlying wood. The resemblance of the pitting to that caused by Tristeza virus in citrus was very marked. In very young coffee, the pits are apparently preceded by pockets of gum developing under the bark.

Further examination of coffee both at Lyamungu and in the Kilimanjaro-Meru area disclosed that the stem swelling and pitting were present over a wide area in young coffee planted in 1953 and thereafter. Die-back was not invariably present in the affected trees: at Lyamungu, the selection N39 revealed swelling and pitting of the stem but no die-back, yet H66, KP423 and N197 selections in the same trial had declined severely and there were numerous deaths. There was a definite correlation between the extent of the pitting and the appearance of the trees, pits always being more numerous much deeper in trees that had died or were dying-off.

Stem swelling and pitting were found later in Kenya (Ruiru) and this condition is now reported from Brazil, accompanied by die-back.

Present evidence suggests that this is not a soil condition owing to the wide distribution and the fact that coffee planted prior to 1953 is apparently unaffected.

Dr. F. J. Nutman of the Kenya Department of Agriculture very kindly carried out sectioning and staining of affected material. Sections showed (a) considerable disorganization of the stem cambium and (b) the presence of double and triple nuclei in cells within the affected region. While there is as yet no direct evidence to support the hypothesis that this condition of coffee is caused by a virus yet cell abnormalities are common in virus diseases and the presence of more than one nucleus is at present only known in virus infections.

To test the virus hypothesis, inoculations of sap from affected trees (stems and leaves) have been made to young, apparently unaffected coffee seedlings. No symptoms have yet developed in the seedling stems and no leaf symptoms have been noted. Grafts of scions from affected coffee to seedling material have been carried out by Mr. Fernie, Horticulturist, Lyamungu; these and trials with dodder to transmit the condition from affected to healthy coffee are still in progress.

Tobacco.

Seed-bed disorders.—A visit to Iringa to investigate tobacco seed-bed troubles was made in November. Apart from minor fungal diseases and local insect infestations, the main source of trouble with seed-beds was found to be the very low standard of management. Despite intensive propaganda and efforts by the Agricultural Officer (Tobacco) to improve matters, a great deal needs to be done in the direction of management.

Tomato.

Mite damage.—Cases of severe foliage distortion, leaf-rolling and stunting were investigated on African shambas near Moshi. At first sight, the symptoms looked like those caused by some viruses but subsequent examination revealed the presence of numerous mites. In the absence of the Entomologist on leave, suggestions were made for control with sulphur dust.

E. A. Riley,
Plant Pathologist

ENTOMOLOGY, LYAMUNGU

Review.

The Entomologist was away most of the year on a course in the United States of America and on vacation leave.

White Coffee Borer (Anthores leuconotus).—All experimental work on the biology and control of this insect was completed in March, but remains to be written up. Almost all plantation coffee in the "borer belt" has been treated as have some African areas. The results obtained have fully confirmed experimental results and on several plantations at least the pest has been virtually eliminated.

Some observations on the persistence of dieldrin in a lacquer formulation still need to be made.

Stephanoderes (Hypothonemus hampei).—Five plots of coffee, each 300-400 coffee trees, were selected for treatment in the heavier "Stephanoderes" infested areas of the Bukoba District. Similar plots were marked off nearby as control. In the treated plots each tree was sprayed with approximately $\frac{1}{2}$ grm. of endrin in $1\frac{3}{4}$ pints of water. The trees were first sprayed at the end of 1955 and again at the optimum period in June, 1956. Samples of cherry were taken monthly from treated and control plots. Results were assessed by the amount of Stephanoderes damaged cherry in the samples as it is not practicable to assess actual insect populations.

Pre-sprayed counts showed that 40 per cent of the cherry was damaged in all plots. By March April the percentage of affected cherry had gradually declined to about 10 per cent of the total cherry while in the "control" plots the percentage of affected cherry had risen to 45 per cent. After the second spraying, when the main crop was off, the percentage of damaged cherry dropped to 5 per cent and remained steady at that level for the rest of the year while in the control plots the damage rose steadily from 45 per cent to 55 per cent towards the close of the year.

In addition there was a significant drop in the incidence of minor cherry pests in the treated trees although the actual reduction was not important.

Leaf-Miner (Leucoptera coffeella).—The importance of the loss of leaf caused by leaf-miner is subject to much controversy. In an attempt to decide this problem a number of trees on the Coffee Research Station have been treated with different insecticides to control leaf-miner while other trees have been left untreated. At the end of the year there was a marked difference in the appearance of the trees. Those treated were dark green in colour due to the retention of mature leaf, while those untreated were definitely shy in leaf and appeared a light green colour due to preponderance of new leaf.

It remains to be seen whether the difference is reflected in the crop yields.

An off-station trial was also made, but differences in the trees were not so noticeable.

Thrips (Diarthrothrips coffeæ).—Reports were received from Oldeani that the common coffee thrips, normally easily controlled with DDT, was not affected by this insecticide at twice the normal dose. An investigation in the field confirmed that this was the case, but that DDT sprayed at 0·4 per cent level, i.e. 4 times the usual dose, did effect a fair control for a week. Dieldrin at 0·05 per cent level, Chlorothion at 0·1 per cent and Parathion at 0·05 per cent gave good initial kills, but there were signs that the populations were recovering after eight days.

As a result of this apparent DDT resistance it is estimated that almost half of the coffee at Oldeani has suffered severely.

R. Tapley,
Entomologist

GENERAL EXPERIMENTAL WORK, NORTHERN PROVINCE

During the year experimental work in the province was considerably reduced, mainly as a result of the re-organization of Tengeru. Such experiments as were maintained at Tengeru were left on a care and maintenance basis under the charge of an unqualified field officer for most of the season and any results obtained are suspect. Statistical trials in the districts were reduced to a minimum but a good deal of experimental work in the way of trial of new crops and varieties or of different agricultural techniques was done and the results recorded. Where it entails little additional work such trials are laid out statistically but the vast majority are in the form of observation plots.

The main work of interest recorded during the year was a series of maize spacing trials carried out by the Agricultural Officer, Arusha, which indicated very clearly that the optimum spacing for maize depended very largely on the amount of moisture available to the crop. Rain falling prior to planting was of equal importance to rain falling after planting. Two trials carried out by the same officer comparing three different maize varieties of different maturity periods planted at three different times gave interesting if somewhat negative results in that although, as was anticipated, the long maturing variety heavily outyielded the short maturing variety when planted early it still outyielded it, though by a much smaller margin, when planted late. However, this trial was complicated through the different growth habits of the varieties which obviously demanded different spacings in order to yield their optimum and to obtain a useful comparison of the interaction between varieties and dates of sowing the optimum spacing for each variety would have to be determined first or else a complex three factor experiment devised (Variety—time of planting—spacing).

A series of observation plots covering a range of maize varieties, some hybrids from Southern Rhodesia and Wisconsin, U.S.A., and some self perpetuating varieties from various countries, was grown at different centres. The main result was a convincing demonstration that genetical material for early maturity was available in several exotic varieties but none of the varieties tried appeared in themselves to be outstandingly superior to strains available locally. With the appointment of a Botanist to work on the improvement of maize varieties it is hoped that this side of the Department's activities will make a definite forward stride.

In Moshi District experiments indicated that in dryer areas ridging increased yields of maize and a comparison of furrow irrigation of cotton versus flooding indicated that furrow irrigation gave higher yields. In all such trials however it is difficult to isolate the effect of ridging *per se* without the other factors such as increased cultivation which normally accompany ridging coming in.

Observation plots covering different aspects of the cultivation of the following crops were planted in different parts of the province : Maize, cotton, groundnuts, haricot beans, peas, french beans, sesame, soya beans, coffee,

cassava, chillies, coconuts, cashew nuts, pineapples, cowpeas, onions, potatoes, oranges, pecan nuts, pyrethrum, finger millet, sorghum, Rhodes grass, *Setaria splendida*, Russian comfrey, sunflower, tobacco, tomatoes, wheat, rice. There are no outstanding results to report from these trials although a considerable amount of data useful to the local officers was obtained.

L. J. S. Littlejohn,
Assistant Director

GENERAL EXPERIMENTAL WORK, TANGA PROVINCE

Experimental work during 1956 was affected by the rainfall, which has almost everywhere been well below average, and over most of the lower areas was particularly poor in June and July, the latter part of the growing season.

Kungului Farm

Potato Variety Observation Trials.—No new varieties were received for planting in 1956. The five varieties left on the farm were planted in December, 1955 and again in August, 1956.

1521c (3)—Continued to be free from *Phytophthera infestans*, but was twice infected with *Alternaria solani*. This variety is distributed to European and Native growers as it is the only one which has been planted fifteen times and which has remained free from *P. infestans*.

1564a (14).—This variety stood up well for the first ten plantings, but since then has gone down with *P. infestans* three times. It will now be discarded.

1673b (4).—Out of nine plantings *P. infestans* has been contracted three times. This variety will also be discarded.

1664a (1).—This variety has not contracted *P. infestans*. It has been planted ten times and trials will continue. As with 1521c (3) *A. solani* has been noted several times.

1668a (2).—This variety has also remained free from *P. infestans* for ten plantings. Trials continue.

The following are the results of the 1956 trial :—

Variety	Sets Planted	Yield lb.	Average lb. per Set
1521 c (3)	50 ...	59 ...	1·18
1564 a (14)	50 ...	57 ...	1·14
1673 b (4)	50 ...	41 ...	0·82
1664 a (12)	50 ...	40 ...	0·80
1668 a (2)	50 ...	41 ...	0·82

Sweet Potato Observation Trials.—Fourteen varieties were planted on 25th June, 1956, and harvested on 12th March, 1957. Thirty plants of each variety were planted at one foot intervals on tied ridges, five feet from crest to crest. All varieties (with the exception of Kaunga Mkubwa which failed to yield) were replanted on 12th March, 1957. The results of this trial over the last five years are shown in Table 1. The poor results in 1956 can be attributed to the long, dry spell between May and November.

TABLE I

Yields from thirty plants

Variety	1956 Yield lb.	1955 Yield lb.	1954 Yield lb.	1953 Yield lb.	1952 Yield lb.	Total lb. 5 years	Average Yield
1. Ngwezi Mungwe ...	47	120	54	56	83	360	72
2. Kwata (Handeni) ...	68	90	93	86	90	427	85
3. Kaunga Mkubwa ...	Nil	4	14	3	68	89	18
4. Kakoma...	47	18	76	44	125	310	62
5. Kandolo (H)	29	48	45	30	103	255	51
6. Mwarusha	42	77	75	18	109	321	64
7. Kwata (local)	40	59	57	37	65	258	52
8. Bwaza	75	150	103	97	98	523	105
9. Mgeni	30	90	94	100	71	385	75
10. Iringa	63	185	85	90	107	430	86
11. Londoza...	32	83	56	22	87	280	56
12. Caroline Lea	56	168	88	35	54	401	80
13. Halimtumwa	47	68	46	48	72	281	56
14. Kondole (L)	32	30	31	12	114	219	44
15. Kibibi	55	40	60	69	94	318	64

Soft Fruit.—The Melba and Cambridge Early Pine Strawberries were re-planted and bore moderately well.

The Boysenberries and Youngberries were manured, but yields were small. A heavier application of manure is to be made this year.

Deciduous Fruit.—The fruit section of the farm has been kept clean and weeded. The seven Queensland Nut trees planted in October, 1952 are now approximately 8 feet high.

The Coffee fertilizer trial put down in 1954 made good growth, as did the bananas interplanted for shade. The older patch of coffee on the multiple stem system is due for changing to a further cycle in 1957.

Usambara Scheme (B) Plains

Trial work in the Usambara Scheme "B" Plains areas has been broadly grouped under three main headings :—

Dry (i.e. non-irrigable) land observation plots have been continued at Kwamdulu and Komsala and three new plots on three different soil types have been started at Mtakuja. This work, the results of which are given in Table 2, falls geographically and climatically into the same category as the observation work done in Handeni District, and these results may conveniently be compared with those given in Table 4 for Handeni. All these plots fall in the Eastern Handeni area where a very similar range of crops was planted.

Throughout the area rainfall was on the low side and was particularly poor in June and July, i.e. at the end of the growing season, and the most strikingly obvious result of the trial was to illustrate the value of ridging as opposed to flat cultivation and also to illustrate the superiority of tie ridging over plain ridging. This was particularly clear in all varieties of cotton.

Yields at Mtakuja were very encouraging, bearing in mind that this was its first year and the ground was somewhat uneven after the tree clearing.

As regards differences between varieties and species, there was little to choose between the various cottons, though U.K. 51 was actually the highest yielder. Katumbili Maize showed up rather better than the longer-term varieties. This is what would be expected in a year of poor rainfall and strengthens the opinion that in such areas of unreliable rainfall a short-term maize is better than a long-term one, even though in the occasional good year the long-term one will yield higher. It was also quite clear that in these conditions groundnuts will yield appreciably higher than any of the other legumes which were tried.

TABLE 2

USAMBARA SCHEME "B" PLAINS TRIAL PLOTS, LB. PER ACRE

	KWAMDULU Red Soil 3rd year			KOMSALA Red Soil 2nd year			MTAKUJA Red Soil 1st Year		MTAKUJA Black Soil 1st Year		MTAKUJA Brown Soil 1st Year	
	Tie-Ridged	Ridged	Flat	Tie-Ridged	Ridged	Flat	Tie-Ridged	Flat	Tie-Ridged	Flat	Tie-Ridged	Flat
Maize, local Handeni	not planted			not planted			1,168	1,128	1,056	1,024	1,344	1,456
Maize, Katumbili	2,128	2,248	1,084	1,085	672	724	992	952	1,760	1,056	2,224	1,872
Maize, Kongwa Yellow	not planted			not planted			1,440	1,168	2,720	1,976	2,368	1,664
Maize, Hickory King	2,712	2,856	768	1,480	1,056	440	1,480	1,520	1,584	1,552	1,584	1,256
Cowpea	not planted	172	100	not planted	nil	nil	160	104	672	424	144	72
Beans	not planted	200	135	not planted	60	60	120	88	304	280	320	304
Groundnuts	not planted	1,730	1,345	not planted	990	1,210	880	920	1,408	1,272	1,232	1,096
Bonavist Beans	not Planted	172	132	not Planted	132	50	not planted		not planted		not planted	
Chickpea	not planted			not planted			546	354	544	352	144	108
Cotton U.K. 46	410	520	290	260	260	150	not planted		not planted		not planted	
Cotton U.K. 48	410	400	230	320	180	160	674	496	600	456	704	528
Cotton U.K. 51	380	380	230	220	260	100	672	424	632	248	848	496
Cotton 47/10	560	620	180	220	100	110	528	352	568	352	796	432
Cotton B.P. 52B	not planted			not planted			560	352	704	600	706	528
Cotton, local Lushoto	520	400	200	240	120	130	not planted		not planted		not planted	

Work was continued on the irrigation plots at Mngaro at the foot of the northern end of the Western Usambaras and at Magoma in the Luengera Valley.

At Mngara yield figures of various crops are given below for the past three years.

The overall drop in yields from 1955 is considered to be due to the fact that in 1956 the crops were planted several weeks later than in 1955.

In all cases gypsum was applied at the rate of ten tons per acre in 1954 before that year's crops were planted, and the most noticeable point is that in this, the third year, there is some indication that, except for rice, the benefit of the gypsum is apparently being seen for the first time. Table 3 illustrates these points.

TABLE 3

Effects of 10 tons of gypsum applied in 1954 on a number of crops, lb. per acre.

Crop	Year	Treated with gypsum	Untreated with gypsum
Chickpea ...	1954	413	440
	1955	506	484
	1956	110	29
Sunflower ...	1954	900	1,080
	1955	1,100	1,795
	1956	990	905
Cotton (U.K. 51)	1954	927	1,100
	1955	1,135	1,330
	1956	722	437
Groundnuts ...	1954	1,576	1,888
	1955	1,860	1,080
	1956	1,299	913
Panicum Millet...	1954	465	30
	1955	648	42
	1956	27	30
Rice	1954	3,200	2,532
	1955	not planted	not planted
	1956	1,280	1,800
Maize, ...	1954	467	590
Katumbili ...	1955	1,350	875
	1956	1,242	682
Sorghum S.I. 33	1954	553	656
	1955	1,452	1,675
	1956	904	582

At Magoma a rice variety observation trial was laid down, using twenty-five varieties obtained from Ukiriguru. The general impression obtained was that Afaa crosses from the Kilombero as a group were superior to those from Mwanza. Of the Kilombero group, two varieties appeared to be the best, namely 1/166 and 2/229. 1/94 also showed up fairly well. Of the Mwanza group the best was 1/159, with 1/104 also showing promise.

Observation plots of maize (Katumbili), cotton (U.K. 51), beans, sunflower, and potatoes were planted all of which showed up reasonably well but gave no new information. Texas Grano onions yielded over nine tons to the acre.

At Mombo, on dry land in an area of very low rainfall, trials have now been conducted since 1952 with the object of proving and illustrating that sorghum is far more suitable than maize and that ridging is better than flat cultivation in these conditions.

1956, which had a rainfall of 7·29 inches in the growing season, was the last year for this plot, as it is now considered that the points are amply illustrated.

Yields were as follows, the maize being ridged, but the sorghum all planted on the flat :—

Maize, Katumbili	1,276 lb. per acre	
Maize, Hickory King	282 lb. per acre	
Sorghum, Sukumaland 1	924 lb. per acre	
Sorghum, S 26A	1,523 lb. per acre	
Sorghum, S. 131	2,695 lb. per acre	
Sorghum, S. 132	2,145 lb. per acre	
Sorghum, S. 133	2,002 lb. per acre	
Sorghum, S. 144	2,117 lb. per acre	
Sorghum, S. 145	2,695 lb. per acre	
Sorghum, S. 163	1,051 lb. per acre	(damaged by elephant)

Handeni District

Trial work in the Handeni District has been divided into two parts. Firstly, the continuation of work on the Handeni Native Authority Farm and secondly the extension of observation plots through the central and eastern parts of the district.

On the Handeni Native Authority Farm a total of 23·44 inches fell on 83 days. This is some 11 inches below average, and rain in May and June was poor, thus causing poor yields.

The first group of trials was three long-term projects which were continued from previous years. The first, a continuous cropping trial running for its fifth year, showed little result beyond the fact that variation in annual rainfall is still the limiting factor in yields. This trial will need to run for a number of years more before a downward trend in yields due to soil exhaustion is likely to be detected. The other two long-term trials were also on their fifth year and are rotation trials. The rotations in use are :—

1. Cassava, Sorghum, Cotton, Cowpea, Fallow.
2. Sweet potatoes, Maize, Cotton, Beans, Fallow.

Once again, yields showed nothing beyond the rainfall variation factor, and it is intended to discontinue the second rotation. The first rotation will be carried on to serve as comparison with the continuous cropping in future years.

The second group of trials was variety trials of Sorghum, Groundnuts, Hill Rice, Cassava, Castor Seed and Cotton.

Sorghum.—The following varieties were used :—

Lupama, EXBC.27, Ekwangiti, S.131, Enyanza, S.132, S.143, S.145, Wiru Nassa and Wiru Makoge. Of these, S.131 and S.145 were the highest yielders, though not significantly so. This trial has now run for three seasons and rainfall variations have largely over-shadowed variations due to variety.

The local Gobelo type shows up fairly well in comparison with any of the above varieties, and as it stores well, there seems little justification in attempting to replace it at the present.

Groundnuts.—This trial compared Natal Common, PJ121070, ECR4202 and Gambia Bunch with a local variety. This trial has now run four years and indicates that there is little to choose between the four better varieties, all of which are superior to the local variety.

Cassava.—As a result of previous work, twelve varieties were planted on 20th April, 1955, and half of each plot was harvested in June, 1956. Results this year taken with previous results indicate that the best three varieties are 4697/4, 4760/37 and 46110/8, all of which yield well and are adequately free of disease. These three varieties are now to be bulked up.

Castor Seed.—Plots of three locally selected varieties were planted, namely Tolondo, Mpuji and Nyonyo Ntitu. Nyonyo Ntitu yielded considerably higher than the other two.

Cotton.—Five varieties were tried, namely U.K. 46, U.K. 48, U.K. 51, 47/10 and B.P. 52B. U.K. 48 gave the highest yield, a result which agrees with observation plots elsewhere in the district. This trial also incorporated three different spacings. All rows were 24 inches apart, but in the rows plants were at 18 inches, 24 inches or 30 inches apart. The 18 inches and 24 inches spacing showed very little difference, but the 30 inches spacing reduced yield quite sharply.

A considerable expansion of the programme of observation plots took place during the year in selected places spread over the central and eastern parts of Handeni District. The grey/black soil plot at Kwamsisi and the red soil plot at Mgambo which were opened up for the Handeni Preserved Area, were continued for a second year, and five new Native Authority plots were opened up for the first time. All are on red soil, one being at Kwamsisi and the other four being in the central part of the district at Vyadigwa, Kwamkonje Kangata and Mswaki respectively.

The object of these plots is to get preliminary information over a fairly wide range of places and conditions found in these parts of the district, and at each place the following were planted :—

1. Two varieties of maize, local and Katumbili.
2. Two varieties of sorghum, Enyanza and S.133.
3. Five varieties of cotton, U.K. 46, U.K. 48, U.K. 51, 47/10 and B.P. 52B.
4. Groundnuts, Natal Common.
5. Cowpea.
6. Cashew Nuts.

In certain selected plots beans, bonavist beans and white simsim were also planted.

Table 4 gives the results obtained. In each case the crops were planted on the ridge and on the flat.

Results this year show nothing which may be regarded as of particular interest. In general, ridge cultivation is shown to be superior to flat cultivation, though this is less well illustrated on the grey/black soil at Kwamsisi than it is on the red soils.

The season was on the dry side, and results reflect this fact. It is generally believed that all over Handeni the rainfall from year to year varies to such an extent that it often forms the limiting factor in crop yields, regardless of other conditions. Results this season have done nothing to shake this belief.

In general, the sorghums did not outyield the maize, but it should be noted that on most plots the sorghum suffered to a varying extent from smut.

Of the cotton varieties, U.K. 48 and 47/10 generally yielded better than the other varieties, though from such observation plots as these no real conclusions can be drawn.

On all plots, cashew nuts were established. At Mgambo and the black soil plot at Kwamsisi those planted on 10th April, 1955, were forming fruit by 1st October, 1956, and individual trees were bearing by 1st November, 1956. On the five new plots trees were planted in late March and early April and have come away well, except at Kangata where baboon uprooted the whole lot six months after planting.

Same

There has only been a small programme of trials carried out in the Pare District this year, the chief feature of which has been the Saline Soil Reclamation trials at Marwa and Naururu on the Pangani River flats.

These trials are now to be discontinued, as it is considered that they have now given as much information as is required at the present. At Naururu on the lighter soils it has been found possible by leaching to reclaim a highly saline soil virtually in one year. By the second year satisfactory crops of maize were obtained, and this, the third year, again gave satisfactory results. At Marwa, where the soil has a higher clay content, salinity was still present after three years. Clearly, therefore, the Naururu soil type is the more promising for future development projects.

Future development of the Pangani flats depends, however, on availability of irrigation water from the Pangani River. This will in turn depend on whether the dam project now under survey at Nyumba ya Mungu is finally carried out. These trials at Marwa and Naururu have now indicated the direction which should be taken by future experimental work.

The remainder of the work at Same has consisted of two trials :—

A cotton variety and spacing trial in which five varieties were planted. namely U.K. 46, U.K. 48, U.K. 51, 47/10 and B.P. 52B. These were planted at three different spacings. all rows being 24 inches apart but plants in the row being at 18 inches, 24 inches or 30 inches apart. The whole was half ridge and half flat planted.

Results were similar to those in the same trial at Handeni. 47/10 was the highest yielder, though not significantly so. Ridged cultivation was markedly superior to flat. and there was little to choose between the 18 inches and 24 inches spacing, while the 30 inches spacing gave a sharp drop in yield.

Observation plots of six varieties of sorghum and two of maize were planted at seven different places round the foot of the Pare Mountains. At three of these, namely Kiruru, Hedaru and Vudu, the rains were so poor that nothing was harvested at all. At the other four plots rainfall was poor but some results were obtained, as shown in Table 5. Ridged cultivation was much superior to flat, and the sorghums were much superior to the maize. This result is a confirmation of previous work in these same places.

Tanga

Work in the Tanga District consisted of trials on Cassava, Pineapple, Tomato, Maize and Coconut Kilns.

Observation and multiplication plots of cassava were planted at twenty-two different places, using varieties 46106/27 and 4763/16. In general, 46106/27 was used on the sandy soils of the coast and 4763/16 was used on the red soils. Harvesting will not take place until well into 1957, but observations confirmed that these two varieties stand up well and are resistant to Mosaic.

In November one plot of each of five varieties was planted.

Seven varieties of Tomato from Hawaii said to be immune to grey leaf spot were planted. In 1955 all were attacked, but in 1956 one variety remained free of the fungus.

Five varieties of Polysora resistant maize were planted. These consisted of four varieties ex-Amani and ex-Katumbili. While all these varieties showed resistance to Polysora, none gave yields any better than the local varieties.

Two new types of copra kilns were devised and tested. Both produced high grade copra in 1½ to 2 days against the usual 4.

TABLE 4

HANDENI DISTRICT TRIAL PLOTS, LB. PER ACRE

	VYADIGWA Central Handeni Red Soil 1st Year		KANGATA Central Handeni Red Soil 1st Year		MSWAKI Central Handeni Red Soil 1st Year		KWANKONJE Central Handeni Red Soil 1st Year		MGAMBO Eastern Handeni Red Soil 2nd Year		KWAMSISI Eastern Handeni Red Soil 1st Year		KWAMSISI Eastern Handeni Grey/Black Soil 2nd Year	
	Ridge	Flat	Ridge	Flat	Ridge	Flat	Ridge	Flat	Ridge	Flat	Ridge	Flat	Ridge	Flat
Maize, Local	732	696	432	336	1,404	1,332	900	1,440	1,488	1,440	not planted		312	24
Maize, Katumbili	1,452	972	588	576	1,512	702	1,044	1,050	1,644	1,392	1,434	1,248	408	24
Sorghum, Enyanza	1,116	504	684	324	360	216	768	636	1,536	1,728	not planted		504	696
Sorghum, S. 133	1,104	696	912	384	408	384	564	540	1,944	1,368	1,068	780	312	432
Cowpea	144	96	432	288	Nil	Nil	600	648	864	600	not planted		Nil	Nil
Beans	not planted		not planted		not planted		not planted		504	624	not planted		24	144
Groundnut, Natal Common ...	1,008	744	912	1,008	864	Nil	1,284	564	1,056	1,032	756	1,116	600	240
Bonavist Bean	not planted		not planted		not planted		not planted		384	336	468	384	96	72
Cotton U.K. 46	105	60	45	30	390	585	615	285	360	315	320	240	25	37
Cotton U.K. 48	180	75	45	30	660	690	645	240	735	195	320	256	87	62
Cotton U.K. 51	150	30	45	30	465	540	540	210	720	405	368	128	37	75
Cotton 47/10	165	30	105	45	435	420	510	270	1,125	435	464	160	150	37
Cotton B.P. 52B	90	Nil	30	30	390	450	360	225	600	405	304	192	187	87

TABLE 5

SAME SORGHUM AND MAIZE OBSERVATIONS

lb. per acre.

	KWAKOA		LEMBENI		MAKANYA		MWEMBE	
	Ridged	Flat	Ridged	Flat	Ridged	Flat	Ridged	Flat
Maize, IQ M ...	Eaten by pig		273	105	Nil	Nil	168	63
Maize, Katumbili	Eaten by pig		126	42	Nil	Nil	336	315
Sorghum, S. 26A ...	336	336	441	252	31	136	126	294
Sorghum, S. 131 ...	630	546	210	168	21	84	714	294
Sorghum, S. 132 ...	735	462	441	420	63	126	798	546
Sorghum, S. 133 ...	777	567	441	273	52	73	714	294
Sorghum, S. 144 ...	420	294	63	21	21	73	462	294
Sorghum, S. 163 ...	735	588	126	84	31	42	462	210

D. H. DRENNAN,
Provincial Agricultural Officer